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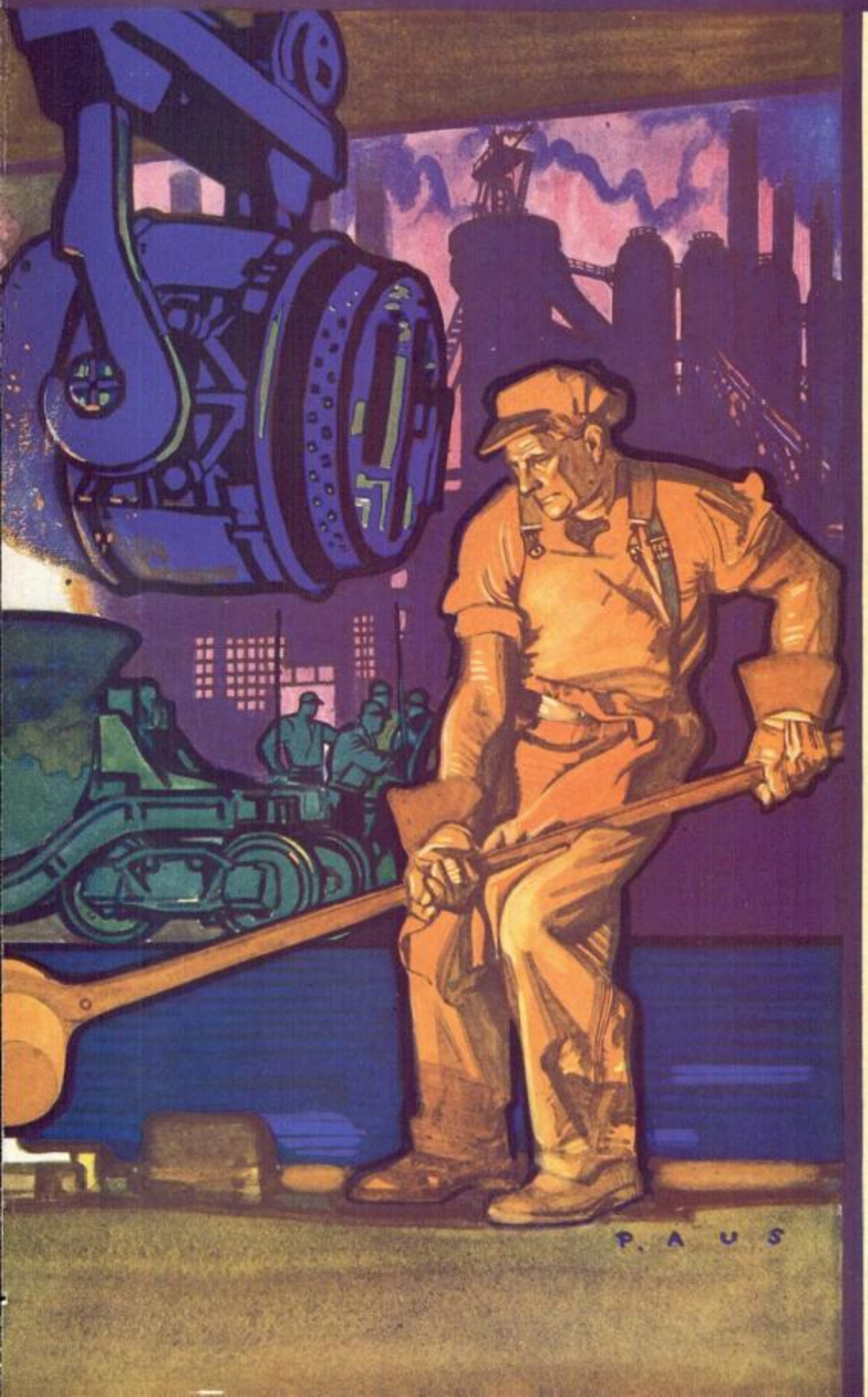

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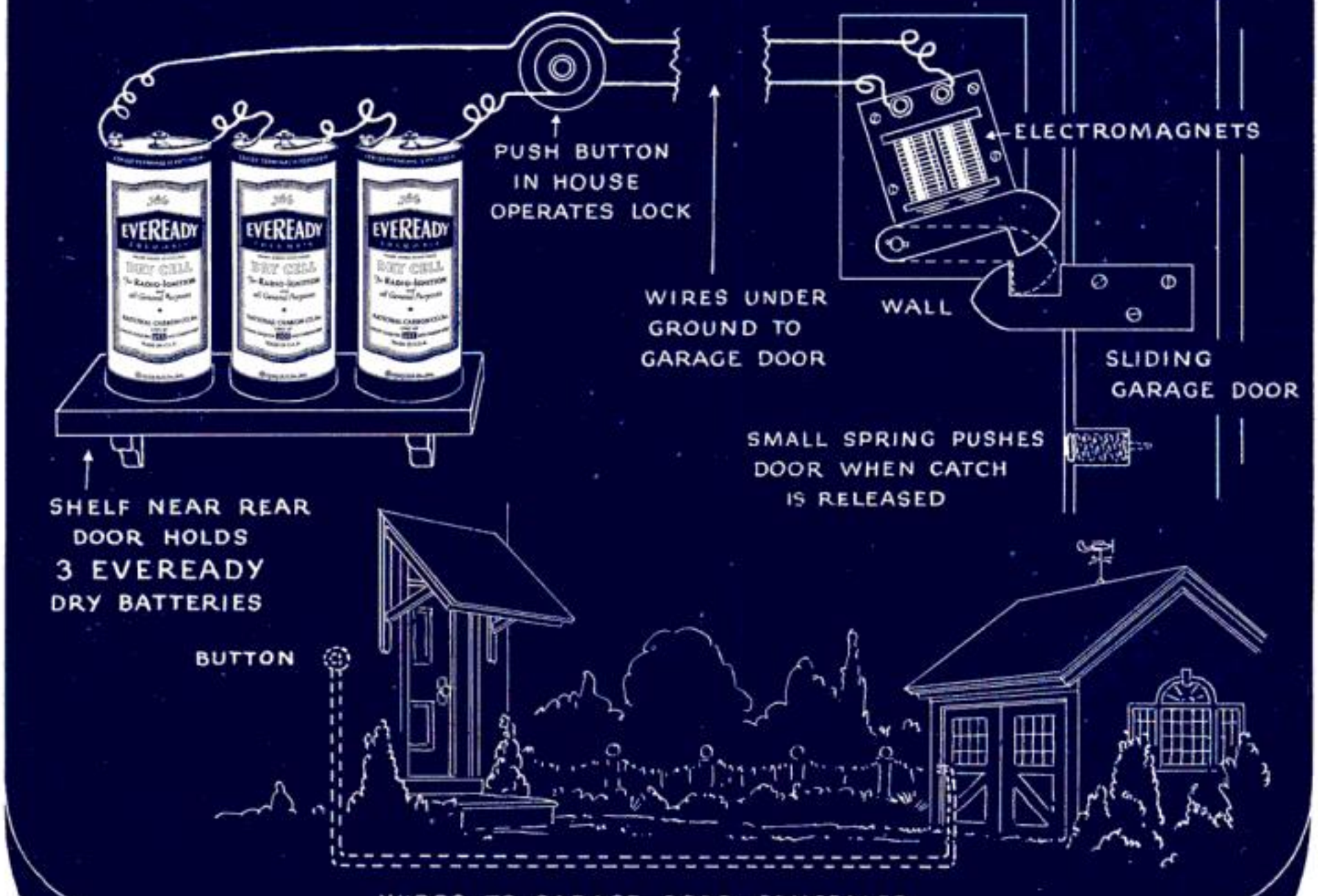

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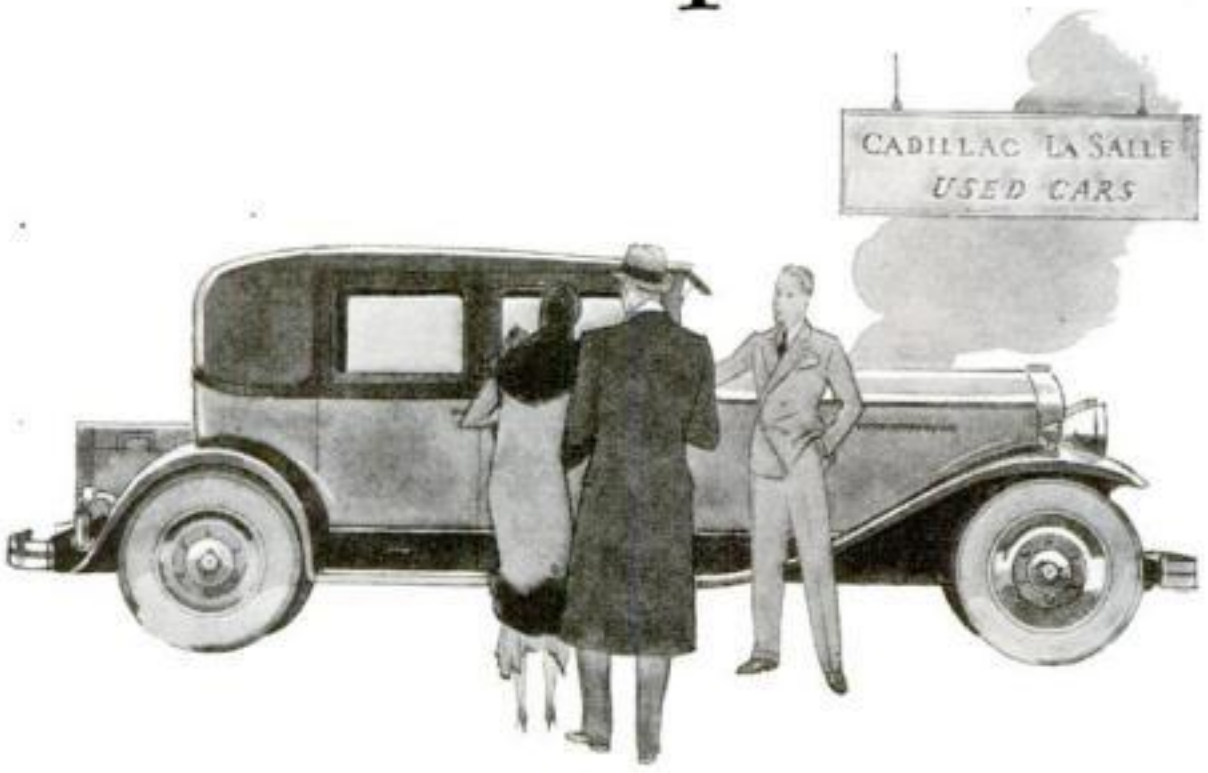

TO keep pace with life today you must have an automobile—new or used.

Used cars meet this need for thousands of people because reconditioned cars are either lower in price; or they are finer built than a new car at the same price and therefore provide transportation of a higher and more impressive quality than the owner would otherwise feel he could afford.

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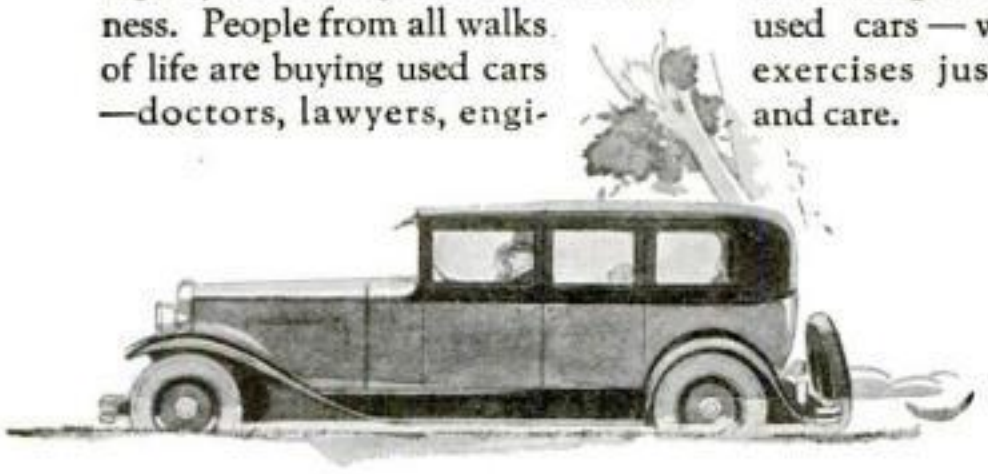
For out and out bargains, there is nothing to compare with some used cars—when the purchaser exercises just a little thought and care.



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February, 1930, Vol. 116, No. 2. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Vice-President and Secretary.

Popular Science Monthly for February, 1930

Trading in CHINESE LAUNDRY TICKETS

By WALLACE AMES, *Financial Editor*

EXPLANATORY foreword: To aid getting ahead through *investment* —that is the object of this department; it does not foster speculation. But something happened in the financial world, beginning October 24, 1929, which affected investors as well as speculators, causing a violent re-adjustment in viewpoint and reasoning as applied to money. What caused all this?

Perhaps a peek into Avery Atwater's diary, with our own interpolated comments, may help to clarify the thinking and understanding of POPULAR SCIENCE MONTHLY readers. Multiply Avery Atwater by several million (others just like him) and you begin to understand how so many people helped to bring about their own financial downfall.

Extracts from Avery Atwater's diary:

January 1, 1924:—"I have worked out a budget plan which will enable me to save $1,000 this year. A year from now I will become a bondholder. In the meantime I am going to make a special study of safe investments. I intend to put my money in something that is absolutely safe."

January 1, 1925:—"The $1,000 I planned to save last year is now in the bank—and a little more. I have decided to buy a bond of the X Company. It will cost me $960 and in ten years will pay me back $1,000. In the meantime I will collect $50 interest each year. My investment banker tells me that there is more than $2,000 of property value pledged as security for my $1,000 bond."

Avery has evidently made a sound investment from the old-fashioned viewpoint of safety . . . his first big step toward financial independence.

July 1, 1925:—"Bill Bowers tells me that he too has become an investor. He has just bought 10 shares of common stock in the X Company, whose bond I hold. His stock cost $90 a share and pays 7% a year on its $100 par value, so he is getting $70 a year on his $900 while I am getting $50 on an investment of $960. I think I will talk to my investment banker about this difference."

BRIEFLY, the comparative positions of stock and bond holders is this: X Company *owes* each bondholder the face value of his bond, *agrees* to repay the amount of the bond at its maturity, and *pledges* security to guarantee the fulfillment of the obligation. In comparison, the stockholder *owns* an interest in whatever property and earnings remain in X Company *after* such prior charges as bond obligations have been met. The stockholder is a partner; the bondholder, a creditor. Since the stockholder takes a subordinate position he is entitled to a higher income (when earnings permit).

January 1, 1926:—"It seems that, more and more, my friends are investing in stocks. Bill Bowers is only one of many who have made money on stocks they bought during the past year. This year I think I will invest my savings in stocks instead of in bonds."

April 1, 1926:—"My stock investments are not turning out so well. After I bought them they both went up to considerably higher prices than I paid. But during the latter part of March the bottom fell out and they are now worth less than I paid. Guess my bond was the best investment after all."

During March, 1926 there was quite a severe decline in stock prices, at least as judged by standards of those days.

Some thought the end of the bull market was at hand. But they were wrong as the action of the stock market thereafter showed.

JANUARY 1, 1927:—"After my experience with stocks last March I thought the best thing for me to do was to stick to bonds as a form of investment, but I guess I was wrong. Bill Bowers tells me that during the latter half of the year he more than recovered his March stock losses. I am planning to invest in stocks again this year and see if I can be as fortunate as Bill."

July 1, 1927:—"Casting up my accounts for the first half of this year I find that I have made a nice profit on stocks. Profits alone, not including dividends, amount to over $500 so far this year. That is a heap better than the $50 a year that I get on my $1,000 bond. I can see where I will be on Easy Street in no time. But Bill Bowers is doing much better than I am. He always seems to be a step ahead of me in this investment business. He trades on margin so that he can carry from two to three times as much stock as I own. His profits amount to two or three times as much as mine—on the same amount of invested money. Bob tells me that he only pays 5% or 6% on his debit balance and that his profits the first half of this year were over 20%. It strikes me as a very profitable arrangement where one can make 20% on money which costs not over 6%. I think I will start trading on margin.

Avery Atwater has now ceased to be an investor and has become a speculator. Judging by the record of his diary he is no longer selecting securities (either bonds or stocks) on their intrinsic merit (earning power plus underlying value) but entirely on the anticipation of an increase in market price which will permit him to sell at a profit.

January 1, 1928:—"Bonds as a form of investment seem to have gone out of style. Nobody talks about anything but stocks. My X (*Continued on page 5*)

Trading in Chinese Laundry Tickets

(Continued from page 4)

Company bond is quoted around $900 now, or $60 less than I paid for it. My broker tells me that all bond prices are off because of the lack of demand and the widespread public interest in stocks. Guess I will sell my bond, take my loss and make it up on some stock."

THE years 1928 and 1929 witnessed such a drastic falling off of bond issues as a form of financing that the old-fashioned bond became all but extinct. It became well nigh impossible to interest people in bonds unless they were convertible into common stock or carried warrants entitling the holder to purchase common stock at a fixed price. This was one of the many indications of the general public afflicted with the speculative craze.

January 2, 1928:—"I sold my bond and bought some stock today. The income yield on my bond was a bit over 5% while the stock I bought only yields around 3%. But I guess that is only a drop in the bucket compared to the stock profits I should make."

The public at large began to reason things out much as Avery Atwater did. Little or no consideration was given to the income yield of securities. There was no limit as to how high or how fast stocks were going up . . . so everybody thought . . . and in this state of mind a mere 4%, 5% or 6% income yield was of little consequence. What a change from the days when stocks had to be sold on a basis to yield a higher income than bonds!

August 1, 1928:—"The stock market has been a bit nervous lately, due to the action of the Federal Reserve Bank in raising its re-discount rate to 5%. Personally I do not understand the significance of this, but I should worry. My stocks went down for a few days, but they are going up again now."

Perhaps this was the beginning of the real reckless period for a giddy thinking on the part of the speculative public.

FEBRUARY 15, 1929:—"I have been a little worried about my stocks lately. The Federal Reserve Board has issued some kind of a warning that seems to cause quite a bit of comment in my broker's office. Prices have fluctuated irregularly of late, but are still so much higher than those I paid that I guess I am well protected."

It is a matter of record that between July, 1928 and February, 1929 the average price of a representative list of industrial stocks rose from approximately 200 to about 320. Brokers' loans (credit on which people bought stocks) had advanced to heights never before approximated. Too much of the country's supply of credit was being absorbed in the stock market; leaving not enough for commerce and trade. Hence the Federal Reserve warning that it would have to take steps to conserve the supply of credit for business.

March 26, 1929:—"I wonder how much interest I will have to pay the broker this month. (Continued on page 6)

Trading in Chinese Laundry Tickets

(Continued from page 5)

Call money shot up to 20% today and things generally look a bit uncertain. But at the rate at which I have been making profits the past year I guess I can afford to pay the high interest rate . . . if stock prices do not drop."

AUGUST 25, 1929:—"I guess there is no end to this business of making money in stocks. I thought the bottom had dropped out of the market earlier this month, but after a little decline they resumed their upward trend with renewed buoyancy. My small beginning with 10 shares of stock has grown into quite an account. I am now carrying 400 shares on margin and am planning to make more purchases between now and the first of the year."

October 24, 1929:—"My dream of riches is over. I was wiped out today in what they say was the wildest break in the history of the market."

The public had finally awakened to the fact that it had been trading in Chinese laundry tickets. It had been buying and selling initials (abbreviations used on the ticker to represent stocks) and had been risking its money in quotations (which it thought would go up forever) with utter disregard for intrinsic values. For years there had always been a buyer who would pay a higher price for a stock. Suddenly the buyers all disappeared and in a few dark days the profit dreams of millions of people faded away.

The moral is clear. When you invest, buy *security . . . management . . . earning power . . . income.* Don't put your money in tips and hopes. Judge by a *record* of performance instead of glowing future anticipations.

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THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

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How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

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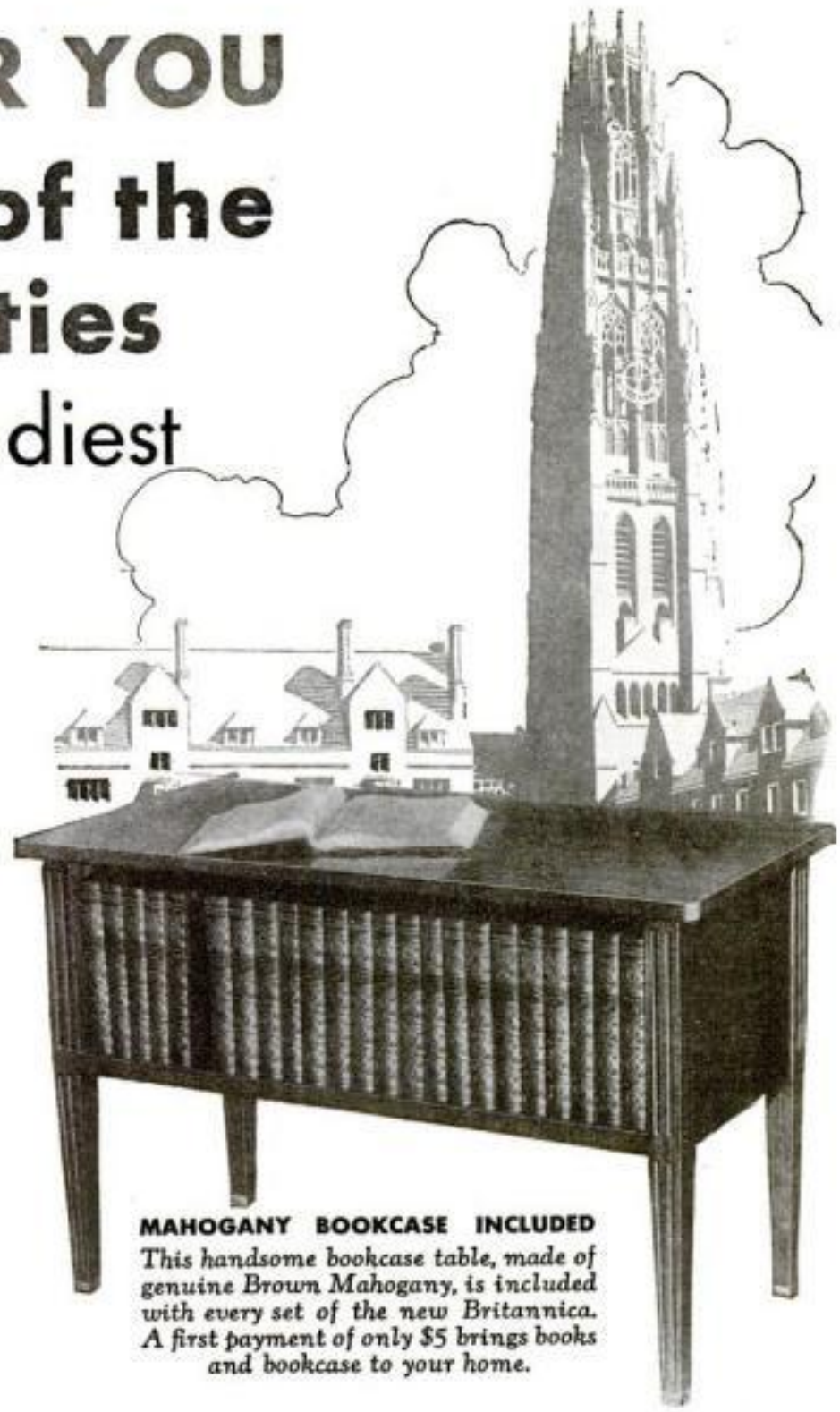

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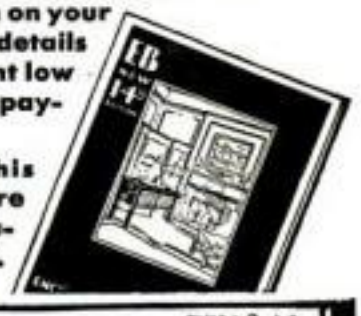

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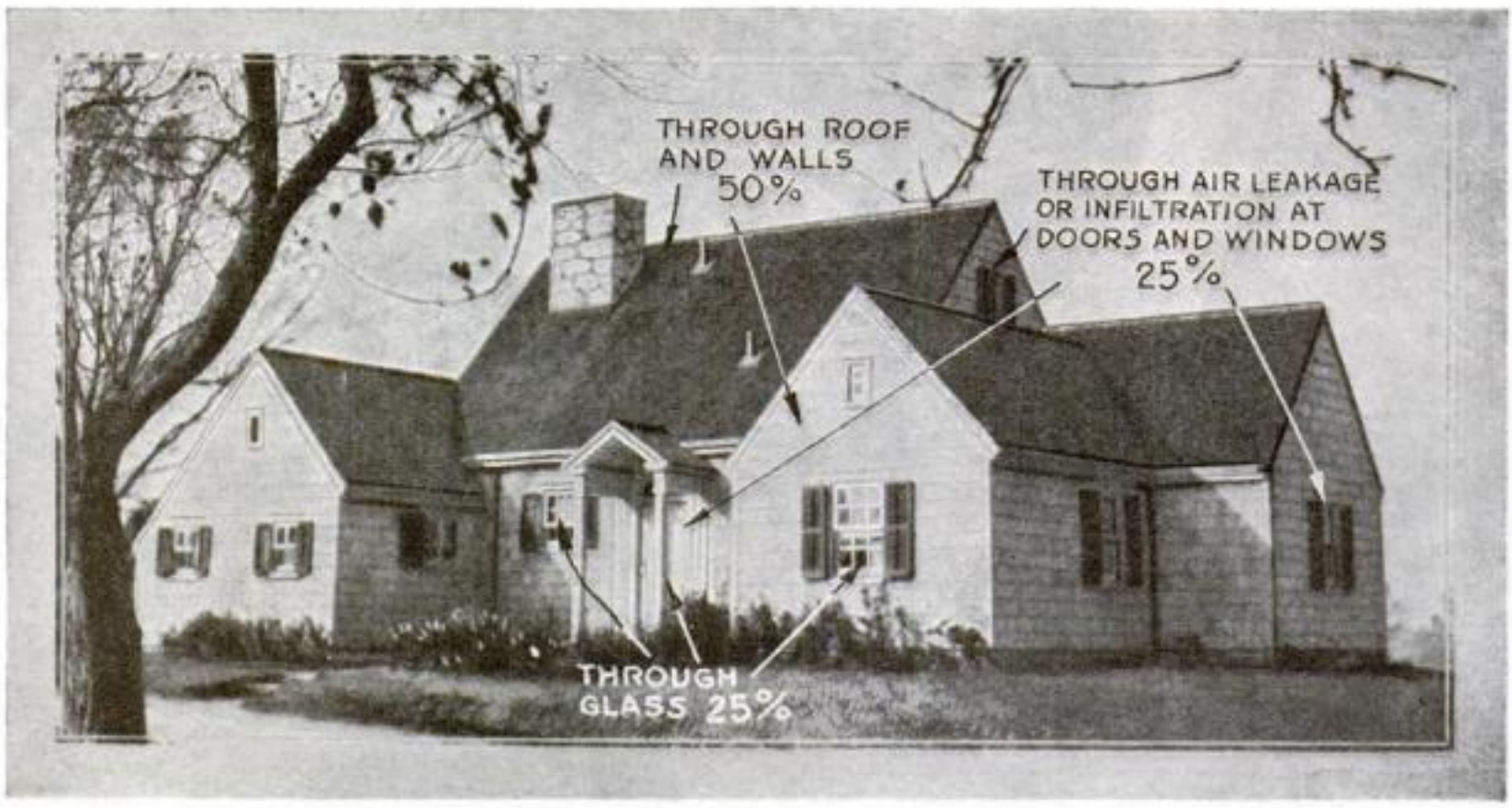
Where Does the House Heat Go?



How the loss is distributed. Most home owners know that considerable heat leaks out through the door and window cracks, but few realize that half of all the loss is through the roof and walls. This can be prevented by incorporating a good insulating material.

Most of It Is Lost through the Roof and Walls; How Careful Insulation Prevents Waste of Fuel

By F. G. PRYOR

Secretary, Popular Science Institute

MOST people carefully bar their doors to prevent any loss of valuables, and at the same time make no particular effort to stop the heat from leaking out of the house through roof, walls, and windows. Fuel is the largest single item of expenditure in maintaining the comfort of the ordinary home, and yet it has been estimated conservatively that the annual waste in fuel in the United States amounts to $450,000,000 just because of poor or unscientific construction of dwellings.

Houses are more or less sievelike in their tendency to let their heat escape. Much of this heat leakage is preventable. For instance, experts agree that from fifty to fifty-five percent of all the heat that escapes from a house goes out through roof and walls, and there is a definite remedy for this in the form of house insulation. Then, twenty-five percent of the waste occurs through leakage at cracks in doors and windows—a heat loss which is partially preventable by the use of such precautions as weather stripping. The only loss that cannot be minimized is the twenty-five percent leakage through the glass in windows.

Frequently, people refer to a house as "well built" or having "good substantial construction" when, as a matter of fact, it is far from being scientifically built from the standpoint of heating. Ordinarily sound construction is not enough to prevent great heat leakage. Special efforts made to keep heat loss at a minimum are well justified by the resulting comfort and economy.

The heat leakage through roof and walls may be effectively stopped by incorporating in roof and wall construction a layer of one of the good commercial insulating materials now available. When the correct thickness of such a material is used, heating costs can be reduced as much as thirty percent or more, and the cost of properly insulating a house rarely exceeds two percent of the entire cost of the building. Take, for instance, a house that is insulated at a cost of $200. The yearly saving in fuel is likely to amount to as much as $50, or twenty-five percent of the cost of insulating. Few investments bring such returns.

However, economy must be considered a minor reason for using insulation. The comfort which it provides is the chief justification for its use. For, despite efficient heating systems, temperature control is a difficult problem in most homes. Sudden drops in outside temperature are scarcely felt inside the insulated house, and the heating worries and constant furnace attendance that usually accompany a change in weather conditions are avoided. Furthermore, a uniform room temperature is possible in such houses, instead of the ten-to-twelve-degree difference between floor and ceiling temperature that is usual in dwellings of ordinary construction. This uniformity of temperature is effective in preventing drafts. Also, while the benefits of insulation are most apparent in winter, the well-insulated house has decided advantages in summer as well. In such a house, it has been found possible to keep upstairs rooms ten to fifteen degrees cooler than the outside temperature.

Until a few years ago, insulation was a subject of practical interest only to manufacturers of refrigerators and to cold storage houses, yet today nine out of every ten architects and building contractors consider it an essential item in modern home building. This general recognition of the advantages of insulation on the part of building experts has been determined by Popular Science Institute in questioning 5,000 architects and builders.

The methods of combating heat loss through window and door cracks are quite well known, and weather stripping, storm sashes, and calking compounds are in fairly wide use. When, in addition to using such measures to reduce the twenty-five percent heat loss at windows and doors, insulation is also used to cut down the doubly great leakage through roof and walls, then a house is scientifically built along modern ideas of comfort.

POPULAR SCIENCE INSTITUTE considers it important that the man who is buying or building a home should know the full facts on the subject of insulation, inasmuch as the term "insulated" is applied frequently to buildings that are not insulated at all, in the modern sense. A booklet has been prepared giving full information on insulation generally, on the materials to use, and their method of application. There is a twenty-five-cent charge for this booklet, which may be had by addressing Popular Science Institute, 381 Fourth Avenue, New York, N. Y.

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Our Readers Say

Too Many Eyeglasses?

CAN any one list some adequate reasons for the tremendous increase in the wearing of glasses by persons of all ages during the past thirty years? To believe the oculists you would have to assume that there was no getting away from the terrible onslaught of spectacles which was destined to engulf the whole human race within a decade or so. But why should this be so? Our ancestors centuries back enjoyed comfortable eyesight reading by candlelight, and assuredly the new flood of electric light cannot be harmful to the eyes, any more than the sun is. Nor have we any reason to believe that we have inherited particularly bad eyes from our progenitors.

There is something wrong in the whole glasses business. If we are not careful, pretty soon those who go without glasses will be unable to get employment or be ostracised from society. What have the eye doctors to say?—K. N. B., Dallas, Texas.

What About This, Randy?

I HAVE just read the article "How I Fly My Plane" by Randy Enslow, and though I am not from Missouri, he will have to show me that some of the things he says are true. I am a pilot myself with a thousand hours credit. Most things he says are correct, but when he came to the part about coming out of the cloud and "I had been flying upside down without knowing it," that's just a little bit too far, in my estimation, to let the story go unchallenged. Where was his "seat sense" just then? Would he not be "hanging on his belt"?

Would he not know by his engine, since few engines run upside down? I admit that a pilot does not know his real position after flying blind for a while without instruments, but he *should know* when he is on his back. The only occasions when he might not know when he was on his back would be in the top of a loop or a barrel roll.

The other statement I cannot agree with is the one, "I find that I can lean back in the cockpit, look up into a *clear* sky, and tell which way the wind is blowing." He confesses he just "feels it in his bones," which is just about correct after all. Just imagination I would say. By watching the ground and watching the "drift" a pilot can sense the wind direction. Another sign I notice is that a ship tends to turn its nose into the wind, especially when it is a cross wind. The gusts turn the tail as on a windmill.—R. L. B., Detroit, Mich.

A Fiery Argument

A. R. M. is all wrong in his objection to the use of the word "noninflammable." There is no such word as "flammable." The prefix "in" does not by any means always mean a negative. Would A. R. M. argue that "intelligible" is the negative of "telligible"? But "telligible" is as good a word as "flammable." We might say "uninflammable" as we do "unintelligible," but it is disagreeable to the ear.

Flame means a *blaze;* to *flame* means to *be in* a *blaze;* inflame to *kindle into* or to *burst into* a blaze. What would "flammable" mean? "Inflammable" is clear, meaning ready to burst *into* (note the meaning of the *in*) a blaze, and "noninflammable" therefore is not a bit confusing, though it is big. It says just what it strives to say and "incombustible" would not do at all, for it means that which cannot be burned or will not burn.

Come, A. R. M., is "instantaneous" the negative of "stantaneous" and "noninstantaneous" therefore confusing?—W. P. C., Missoula, Mont.

Get Out Your Pencil

I WONDER how many of your mathematically disposed readers can answer this puzzle:

An ant made its home at the top of one end of a log which was five feet long and one foot in circumference. A mischievous boy rolled the log a distance of twelve feet. The industrious ant managed to stay on the top of the rolling log, and crept from one end to the other. The ant arrived at the other end of the log just when it completed its distance of twelve feet. How far did the ant travel?—T. O. B., Cincinnati, Ohio.

Yes, but Why?

SIXTEEN and two thirds miles an hour average speed is the answer worked out by a physics teacher and myself to H. D. F.'s problem about the automobile that made the first lap of a speedway at ten miles an hour and the second lap at fifty miles an hour. Is this answer correct?—M. C. A. F., Lott, Texas.

In my way of figuring I get sixteen and two thirds miles per hour for the average speed of the car. Others are trying to tell me different, and I can't seem to make them believe it's right. It is, isn't it?—D. N., Oshkosh, Wis.

A Reader in Trouble

I AM a boy sixteen years old and have been reading your magazine for about seven years. My father likes your magazine as much as I do. When I buy a copy he usually lets me have it in about two days, and then he is forever asking to see it. Do any of your other boys have the same trouble?—L. H., Waco, Texas.

Tailor-Made Inspiration

WHY couldn't X-ray machines of the fluoroscope type be used by textile retailers to determine the quality of the goods they are receiving from the wholesale house? Any "leaded" cloth or shoddy could be easily detected by this method. High-class tailors might employ similar methods to prove the worth of their cloth to prospective clients. Don't think I am bargaining for a patent. The idea came to me while I was trying on a suit.—R. D. K., New York City.

M. O. R. Draws Fire

IN ANSWER to M. O. R., who bemoans the fact that inventions have done nothing to make the life of man on earth any happier, I would say that the inventions he mentions elevate the mind both indirectly and directly; indirectly by conserving his time and energy so that he can indulge in creative pursuits, and directly in that the radio, phonograph, and talking movies bring good music to the people living in rural districts and small towns, and to those in the city who cannot afford concerts, operas, etc.—D. C. B., Parkersburg, W. Va.

I wonder if M. O. R. ever thought of the many lives that have been saved by calling over the telephone, the many successful operations performed at night with the aid of electric light, and the lives that have been saved by rushing toxins to distant places by airplane? If saving life doesn't make man happier, then what does?—G. M. H., Goffstown, N. H.

To answer M. O. R., take the electric light, for just one instance. A scientist is working on a great experiment. A few hours' more work and it is done. It grows dark in his laboratory. He switches on the lights and the experiment which might have failed if it were broken off in the middle goes on, is successful, and humanity is bettered by it. There are hundreds of instances like this to show M. O. R. where he is wrong.—B. T., Wilmington, Ohio.

People who write such letters as that of M. O. R. only do so for the sake of seeing their writing in print. I dare say that M. O. R. received quite a kick when his piece was published. I also believe that he has it well preserved in his scrapbook.—D. R. McC., Springfield, Illinois.

M. O. R. probably enjoys all the modern comforts in his home, drives a good car, uses a telephone in his business, sits evenings reading by the light of a bridge lamp while listening to concert music over the radio, takes in a talking picture now and then and likes them; and still is foolish enough to write such a letter. I wish M. O. R. would tell me how far education would spread if it were not for the invention of printing.—A. A., San Francisco, Calif.

Do You Agree?

I AM second to none in my admiration for the inventive genius and other great qualities of Edison, but I cannot help but feel that by crediting him with the invention of the incandescent lamp during the recent so-called "electric light's golden jubilee" violence was done to widely known historic truth.

The electric light—that is, the arc lamp—was invented by Sir Humphry Davy about 1809. De la Rue made the first incandescent lamp, which had a coil of platinum for a burner and was inclosed in a piece of glass tubing with brass caps, in 1820. In 1840, Grove constructed an incandescent lamp out of a platinum wire burner and a glass tumbler which inclosed it, and one year later the first patent on an incandescent lamp was granted by the British government to de Moleyn. In

this lamp powdered charcoal filled the gap between two coils of platinum wire in a globe from which the air had been pumped.

As everyone knows, Edison greatly improved upon these early attempts and made the incandescent lamp an article of general practical use. But, if we wish to honor the American wizard, why not concentrate upon inventions that are indisputably his, such as, for example, the electric storage battery or the phonograph?—H. L. R., Richmond, Va.

Now—A Walking Fish

I READ with particular interest the short article entitled "A Fish with Lungs" for the reason that the Scouts of my troop have two fish that apparently have lungs.

I will give a description of this fish. It is very scarce, being found in only two places, one of them being Montana. Its common name is "Montana Walking Fish." It has a scientific name, the *Oxolytol* I believe. It has a broad head, somewhat like the catfish. It has no fins. It has four legs, with feet resembling the turtle's. There are five toes on each foot.

It has a broad horizontal tail. There are no scales in evidence. On each side of the body, just back of the head, are three fingerlike projections. These are the gills. When the fish is in water these six gill projections stand out from the body. When the fish is out of the water these are all laid tight against the body.

It can live in or out of water. I understand that they have been known to travel eighteen miles over dry land. I have noticed that every once in a while the fish come to the surface for a little air.

About its locomotion—it swims with great ease; the tail is used to propel it along. The feet are used as brakes to stop it; while swimming the feet are laid flat against the body. Walking seems to be more of an effort. It walks very slowly, and with a zigzag motion, somewhat as one would pull himself along with his hands lying flat on his stomach.—H. W. M., Billings, Montana.

"Printed Gold"

YOUR article on the hardening and tempering of steel under the heading of "Hows and Whys of Hardening Steel" is the kind of stuff I call printed gold. Your magazine stands all alone in its field. Hoping to read more of Henry Simon's comments in future issues.—F. G., Buffalo, N. Y.

Skyscraper Stories

WITH all these record-breaking buildings springing up like mushrooms in New York, it seems to me we need a few rules for skyscraper records. A builder shouldn't be able to tack on a steeple, a flagpole, and a flagpole sitter and win by a head. To be "the world's tallest building" a skyscraper should have to be at least two stories higher than its nearest competitor.—J. A. O., Hoboken, N. J.

Coupling Two Motors

PLEASE tell A. E. W., of Ada, Ohio, who attempts to operate two quarter-horsepower motors on the same job, that he can get a half horsepower in this way if the motors are properly coupled. This means, of course, that the two motors are rated for the same speed and are of the same type and the two shafts are coupled directly together. If he is attempting to operate the two motors through two different belts over different pulleys, unsatisfactory results may be obtained because any slight difference in the belting ratio will make one motor work against the other.—J. R., Jr., St. Paul, Minn.

Hot Off the Workbench

JUST a few lines of praise for your Home Workshop Department. I think it's great. It enables a man to make furniture for his home that is costly to buy, and with the expert advice of your blueprints it is an excellent hobby or pastime. I have quite a few of your blueprints including *Viking*, *Mayflower*, *Santa Maria*, and others. I wish Captain McCann would design the *Nina* and *Pinta* ship models to go with the *Santa Maria*.—H. D., Toronto, Canada.

What Do You Say, Doc?

THERE is a lot of talk nowadays about the marvels of modern medicine and the radical cures effected by surgery. The idea of looking askance at the sweeping benefits which medicine has conferred upon mankind within the past half century is an absurdity, but at the same time may not one be permitted to probe here and there into particular parts of the medical organism?

What I have in mind, for instance, is the undeniable fact that young people, many of them hardly in their twenties, are operated on for conditions which could have been cured by other means, and then die as a result of surgical shock. I believe that a group of statistics on cases of this type would set the public blood boiling within no time.

Where is the blame to be laid? It is difficult to say. What a great many people probably really die of is "diagnosis." I have a friend who went to I don't know how many clinics and saw I don't know how many doctors, and there wasn't any one of the doctors who saw him who could agree with any other as to what was the matter with him. And in the meanwhile the patient gave up the ghost. Give me the self-reliant, all-around country doctor who can see the picture as a whole and knows his stuff.—K. W. G., Portland, Ore.

A Cheap Education

I REGRET that your Better Shop Methods Department is no longer than it is. I learn many kinks from it. Nevertheless I think that your magazine is a mighty cheap way of getting an education. It treats of many subjects and gives the poor man a chance to keep up-to-date on the world and informed of its progress each month.—W. S., Hurley, New Mexico.

No Worse Than Politics

ALL this writing on relativity for laymen is the bunk. You might think that a few here and there really had an inkling what it was all about to listen to them talk. But if you ask them to give the simplest principle of elementary physics they are stumped. It would be all right to try and give the layman a hazy idea of the business if he had anything to go on, but he hasn't. An easy textbook on Newton's three laws would occupy most of us for several years. And a short essay on an introduction to mathematics would carry us to our graves. Yet you can sit in a hotel dining room and overhear some one say that he doesn't agree with Einstein. There are crimes and crimes.—L. T. S., Omaha, Neb.

Big Mystery Solved!

THE origin and dissolution of the Mayas, about whom you published such an instructive article, are not the only mysteries connected with this race. Another riddle that has bothered me quite a bit of late concerns the pronunciation of their name. I think that the first syllable is pronounced like "my," but a rather learned friend of mine swears by the feathered serpent that it should be "may." Will you please clear up this point?—F. B. D., Cleveland, Ohio.

You are partly right. It's "Mä'-ya," which, when said quickly, is similar in sound to "my-a."

Champion of New Cars

IN REFERENCE to the letter of H. L., Jr., it would seem that he has let the "high-powered salesman" make him lose sight of common knowledge concerning the modern motor car. For instance, how can he compare the speed and pick-up of the latest models with that of his "aging crock"? Doesn't this time saver count for anything with him?

Does he dare to pretend that four-speed transmission, down-draft carburetor, thermostats, or oil filters, air filters, silent gear shifts, sleeve valves, tilting lamps, hydraulic shock absorbers, and non-shatterable windshields are mere "thingama jigs"? Apparently he counts for naught the ease of operation, riding comfort, increased power, safety, and reduced wear on motors which these new features give.

The reduced cost per item made possible by mass production can easily account for the radical drops in price of modern motor cars.

As for the "skimping of materials and workmanship," this is a foolish remark. One has only to glance at the fine appointments and roominess of the latest autos to see that there is certainly no skimping there; nearly every part is made by machine and therefore so standardized that a drop in quality of workmanship is next to impossible.

And *I'd* like to see someone offer H. L. a brand new car for another '24 model and see if he'd take it.—C. E. B., Jr., Minot, N. D.

More on the Way

I THINK that your magazine is the best of all, but durn it, there is not enough "shop" in it to suit me! But what is there is sure good! I wish that you could have Old Bill give a talk on drilling kinks and proportionate sizes of pilot drills.—L. G. Bandon, Ore.

Free Guesses—Who's Next?

ON PAGE 38 of your November issue you pictured a pelican showing its queer beak. If, as you state, it is a fact that the queer growth on the bird's upper mandible has a purpose as yet unknown, may I venture to make a guess? To me it seems that the growth could serve two purposes. First, look at it closely and, remembering that the mandible is thrust suddenly through the water in pursuit of fish, cannot you see the resemblance to the keel of a boat upside down on the mandible? And is it too far a stretch to believe that it serves the purpose of keeping the long beak straight on its darting course in the water?

Again, it reminds me of the front sight on a rifle, and as the pelican must send its beak straight to the fish and as its eyes do not appear able to see the end of its beak from their position in the bird's head, cannot the growth also serve as a sight to send the beak home on the fish?—W. R. B., Dallas, Texas.

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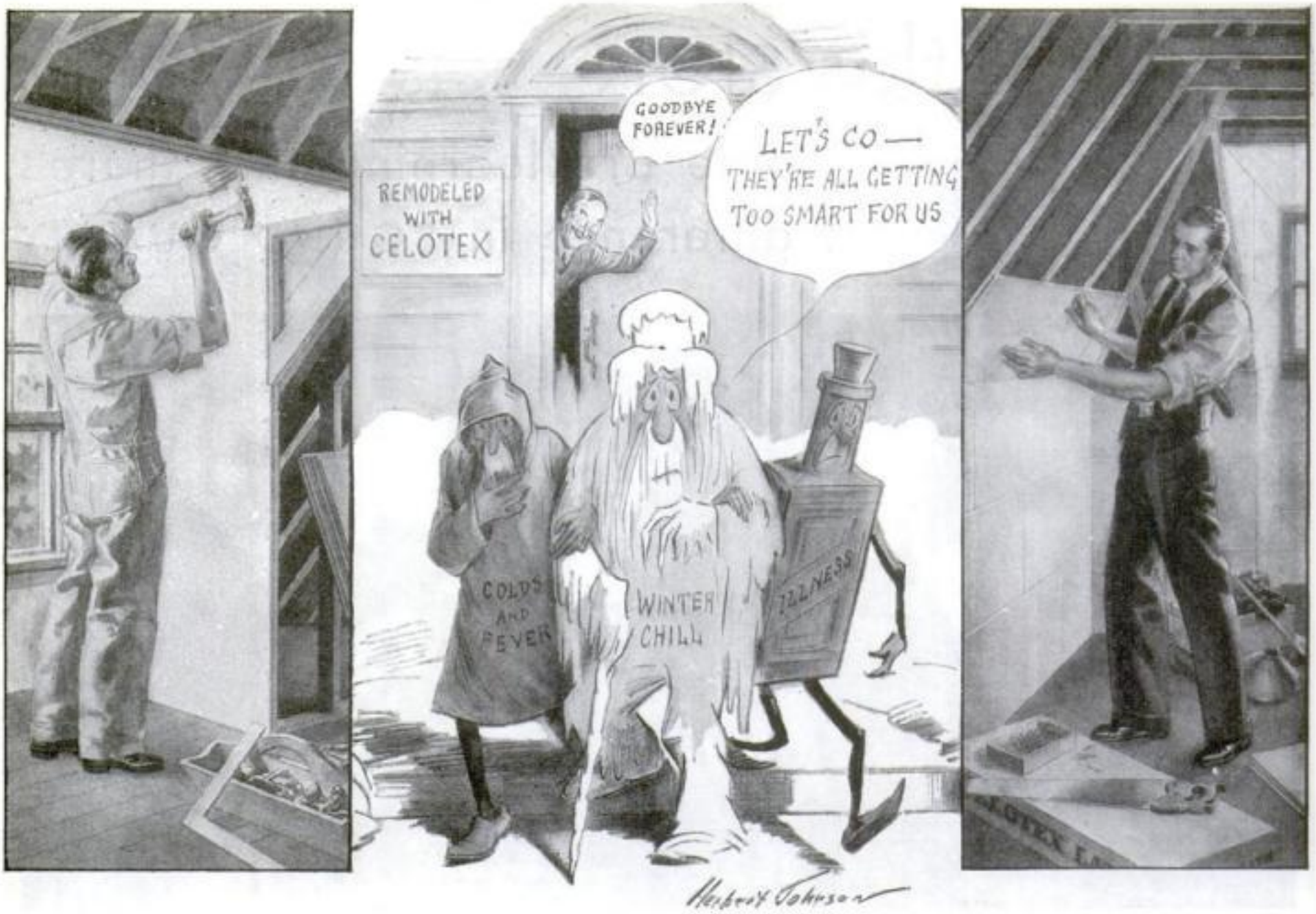

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Shall Speed Laws Be Abolished?

A somersault off the road. Sudden sharp curves such as this are a constant menace to motorists, especially if not banked.

IN THE face of increasing highway congestion and a mounting toll of accident and death, the public is demanding swifter travel with greater safety. How can it be done? POPULAR SCIENCE MONTHLY presents here a definite working plan to solve the problem.

By THE EDITOR

"ABOLISH all the speed laws!"

With that drastic suggestion, Paul G. Hoffman, Vice President of the Studebaker Corporation of America, exploded a bombshell at a recent meeting of the National Safety Council in Chicago. The members of the Council, gathered to consider methods of promoting safety in various fields, had devoted much time to the urgent problem of automobile speed limits. They were frankly amazed when a prominent automotive executive arose to advocate that, instead of working for more rigid laws, the Council should use its influence for the abolition of all speed regulations.

A diametrically opposite stand was taken by Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Co. Basing his argument on an analysis of 73,050 accidents over a wide area in 1928, he contended that the United States, far from being ready to increase or remove the speed limit, might find it necessary to tighten its legal grip on the motorist.

WILL Hoffman's proposal lead to the solution of the speed problem? Will lifting the lid, instead of clamping it down, get cars where they want to go in less time and with fewer accidents?

Or will Dr. Dublin's idea that stricter laws should be passed and enforced prove the panacea for America's serious motoring ills?

Certainly present conditions are untenable. Highways are becoming choked with cars. Pernicious traffic strangulation is setting in, and no one can tell what grave results may follow unless some remedy is found. More people are killed and injured by automobiles than ever before. Last year, the number of lives thus destroyed in this country exceeded half of the total number of Americans killed in the World War. And a million persons were injured—roughly four times the total of United States casualties during the year and a half of American participation in the war.

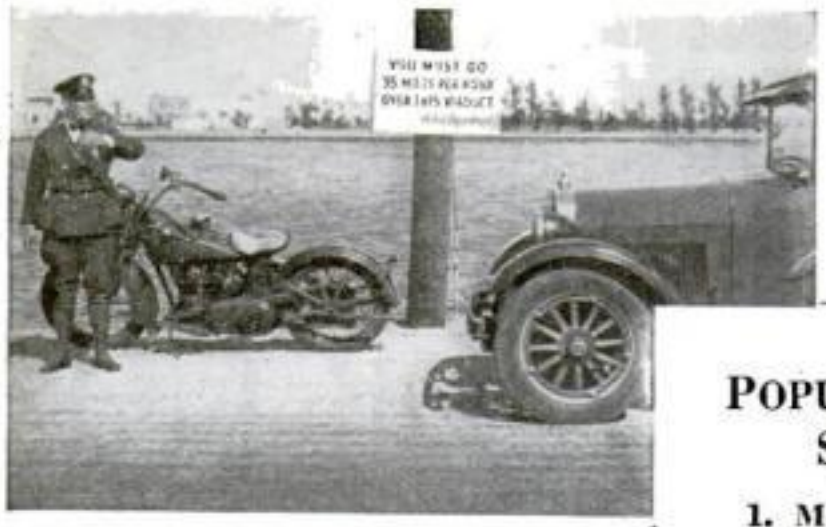
These appalling figures might well be considered sufficient ground for outlawing the automobile as a frightful menace to life and limb. Surely, the argument against the motor car on this basis is as strong, if not stronger, than that against firearms, drugs, or liquor, and perhaps all three combined.

HERE then, is a double-barreled problem. People want fewer accidents. On the other hand, they are demanding greater speed. The importance of this two-headed question becomes evident when it is considered that 25,000,000 automobiles are in use in the United States. It is of direct personal interest to the millions of persons who drive and ride in these cars and, because of the safety factor involved, it indirectly affects everyone else.

For these reasons, POPULAR SCIENCE MONTHLY has made a study of the subject. The principal purposes of the investigation were:

1. To ascertain the views of men who, by virtue of their position and experience, are thoroughly conversant with the situation.
2. To formulate, on the strength of facts thus discovered, a plan for the solution of the traffic problem which, in our opinion, would meet all major requirements.

The survey developed several interesting points. Chief of these was a consensus that better roads and more of them are indispensable to any attempt at remedying existing conditions. Then, it was found that a majority of leaders in the automobile industry shared Hoffman's opinion that higher speeds are not only desirable but inevitable. Finally, those consulted were in virtual agreement that most accidents are not caused by speed itself, but by the use of too much or too little speed at the wrong times; by cars trying to pass each other; by defective automobiles; and by the chaotic state



Minimum instead of maximum speed limits are not so fantastic as they seem. On this viaduct at Miami, Fla., drivers going less than thirty-five miles an hour may receive a ticket.

of speed and traffic laws, which makes it virtually impossible for even the most law-abiding driver to stay within the law.

The survey further indicated that Hoffman's suggestion at the meeting of the Safety Council was not quite as fantastic as it sounded, but was an attempt to crystallize public opinion on the matter of speed. Eight of the forty-eight States already have done away with speed restrictions on open country roads. They are Connecticut, Vermont, Georgia, Tennessee, Michigan, Wisconsin, Kansas, and Montana. In Georgia, an exception is made for heavy vehicles, which may not exceed forty miles an hour. In England, the government recently introduced a bill to abolish the speed limit for private automobiles and to impose instead heavy penalties for careless driving.

SHORTLY after the Chicago meeting, Benjamin G. Eynon, motor vehicle commissioner of Pennsylvania, proposed the elimination of top-speed limits. Where such laws are in force, the commissioner stated, the efforts of enforcement officers are diverted from measures to eliminate recklessness and accident hazards. While under certain conditions on straight highways some operators drive safely at fifty or sixty miles an hour, speeds of ten to fifteen miles an hour are hazardous at points of danger, he said, and it is at these points that enforcement is necessary.

Commissioner Eynon recommended increased highway widths, adequate banking of all highway curves, skidproof road surfaces, elimination of one-way bridges, turnouts on which buses may load and unload passengers, sidewalks for pedestrians, and highway lighting.

In his address at the Safety Council meeting, Hoffman recalled that in the early days of the railroad in America, a speed of fifteen miles an hour was denounced as dangerous and unholy, and that even the innocuous bicycle, in the more or less gay nineties, served as a target for the rural lawmakers. Laughable as these old-fashioned prejudices now may seem, he said, the automobile has been the victim of similar vagaries of fickle public opinion—and still is. In 1910, the average speed on improved highways was about twenty miles an hour. It increased about one mile an hour each year until 1928, when it reached about thirty-eight miles an hour. In that year, the Ford "Model A" started skimming along the roads and it is anybody's guess what the average speed is today.

POPULAR SCIENCE MONTHLY'S Speed-with-Safety Plan

1. More roads, wider roads, smoother roads, and safer roads.

2. Legal road speeds as high as are proved safe by scientific tests for dry and wet going.

3. A law, rigidly enforced, making it illegal to pass the car ahead.

4. Operation of all cars at legal speeds established by scientific tests for various sections of the road, and posted at intervals along the road—no car to move faster or slower than that speed.

5. Spacings between cars to be established and posted in a similar manner.

6. Frequent inspection of all cars for mechanical defects, regardless of whether the car is two weeks or ten years old.

These new Fords, he declared, are proof, if proof is needed, that the motoring public now demands speed and plenty of it.

After declaring that improvements in motor and brake mechanism, body strength, and visibility have made the modern automobile more than twice as safe as its predecessor of fifteen years ago, Hoffman said:

"Traffic and safety experts, men who have studied the question, know that speed in itself is not the source of peril it is popularly credited with being. It is not speed alone, but speed in connection with other factors, such as negligence and recklessness, that makes for accidents."

He predicted that, with the remnants of pedestrian prejudice removed, touring speeds up to 100 miles an hour will become common in the future.

With these views we found a number of prominent men in the automobile industry to be in virtual accord. H. H. Franklin, President of the Franklin Automobile Company, for example, is convinced that higher motor speeds are bound to come.

"There is a definite public demand for greater speeds," he told us. "Airplane transportation is one evidence of this general trend. Higher speeds would increase the usefulness of the automobile."

THE evils of slow driving were emphasized by L. A. Miller, President of the Willys-Overland Company. In his opinion, many accidents are due to slow moving vehicles on crowded highways.

"Drivers attempt to get around the slow movers and this must be done in the face of oncoming traffic," he declared. "I do not believe that speed is responsible for most accidents, but rather that lack of speed and incompetent and careless drivers cause them. Most manufacturers will continue to increase power in order to provide better all-around performance."

Alvan Macauley, President of the Packard Motor Car Company, agreed that accidents are largely caused by inattentive driving. "A fifty-mile touring speed," said he, "is safer today than thirty-five or forty miles an hour was ten years ago."

Invariably, however, these automotive executives pointed out that greater

Is recklessness rather than speed the cause of accidents? Cutting into the wrong traffic lane to pass the car ahead resulted in this jam.

Descending a hairpin turn on a winding mountain road. One flaw in brakes or steering gear may mean disaster. Will danger spots like this be abolished?

speeds should not be attempted before road conditions have been improved. This general opinion was voiced emphatically by G. M. Williams, President of the Marmon Motor Car Company, who doubted the possibility of greatly increasing touring speeds unless they are predicated upon a plan for through high-speed highways of sufficient width and without level crossings or intersections.

"Such a plan," he told us, "already is being carried out in Europe. From Milan to Lake Como, in Italy, for instance, where there are no obstructions whatever on a perfectly level, well-built, wide highway, I have traveled at speeds in excess of 100 miles per hour with a feeling of the utmost safety."

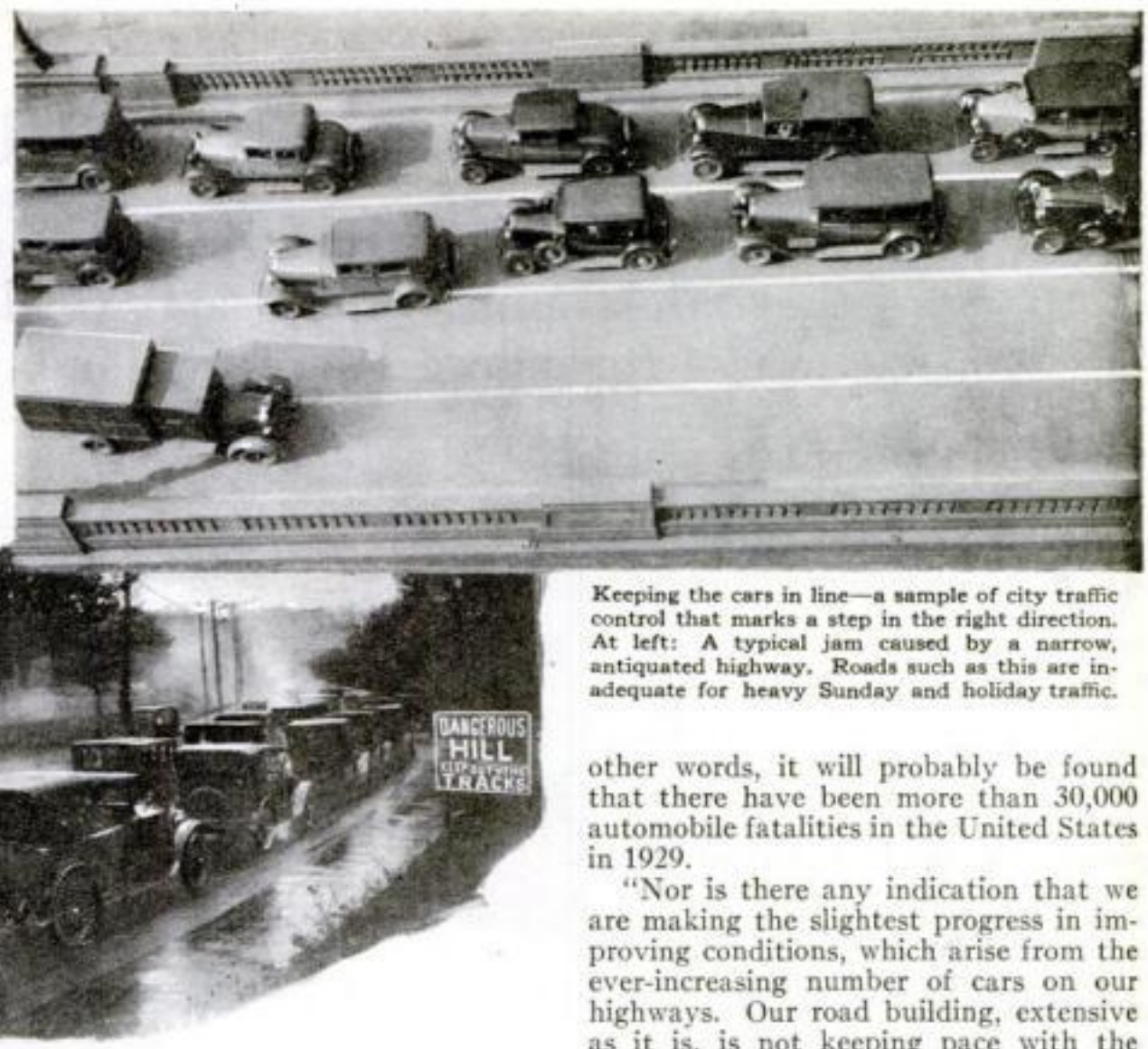
He added that the chance for mechanical failure in a properly designed automobile was no greater at 100 miles an hour than at fifty—provided the car were in first-class condition.

On the question of how to determine the highest safe speed, F. J. Haynes, President of Durant Motors, Inc., voiced the opinion of most of the experts.

"For many years," said this executive, "I have made it a practice, while driving fast, of regulating my speed to the clear space ahead. If it is ten feet, then my speed is such that I can stop at that distance. If it is greater, then my speed can be increased. This method I have found entirely satisfactory and workable. I believe it is the only rule which can be successfully made to apply properly to speed regulation."

The foregoing opinons summarize briefly the attitude of the automobile industry as a whole toward the speed problem. The men whose views are given are authorities on the subject so far as the mechanical possibilities of the motor car are concerned. While it may be argued that the automobile men are naturally prejudiced, it is safe to assume that none of them is so shortsighted as to make suggestions which, in the end, would injure his own business.

Still, there is another side to the picture. Mechanical perfection alone is no safeguard against mishaps. After all, an accident is just as deplorable whether the victim is killed or maimed by a glistening Hispano-Suiza, fresh from the shops, or by a rattling, rusty delivery truck that has cheated the city dump for years.



Keeping the cars in line—a sample of city traffic control that marks a step in the right direction. At left: A typical jam caused by a narrow, antiquated highway. Roads such as this are inadequate for heavy Sunday and holiday traffic.

The insurance companies have reduced the study of accidents and their numerous causes to a science. As has been seen, it was Dr. Dublin, statistician of the Metropolitan Life Insurance Co., who challenged the Hoffman proposal to abolish speed laws.

"It is my belief," Dr. Dublin told us, "that our accident situation is now so disturbing largely because of the current vogue for speed and speeding. The year 1928 saw 27,500 lives snuffed out in automobile accidents in the United States, and about a million persons injured. The money loss was about a billion dollars—not counting the value of the lives destroyed.

"And in 1929, it will be shown, the situation has been much worse still. In the first nine months of the year, the number of deaths from automobile accidents was eleven percent higher than in the corresponding period of 1928. In other words, it will probably be found that there have been more than 30,000 automobile fatalities in the United States in 1929.

"Nor is there any indication that we are making the slightest progress in improving conditions, which arise from the ever-increasing number of cars on our highways. Our road building, extensive as it is, is not keeping pace with the number of cars being turned out. That means road congestion. Irritation on the part of many drivers is expressed in an overpowering desire to speed in order to make up for lost time as soon as they reach the open road. Herein lies the explanation of many serious accidents which occur immediately outside of our congested cities."

IN THE National Safety Council's recent study of 73,050 accidents covering a wide area in 1928, it was shown that speeding was the most important factor responsible for mishaps. Of 2,560 fatal accidents, 720 or twenty-eight percent were due to speeding. Of nearly 37,000 accidents in New York State in 1928, 4,485 or 12.2 percent were recorded as having been caused by exceeding the speed limit; 11.3 percent by driving off the roadway, in a majority of cases a concomitant of speeding; and 15.7 percent by driving on the wrong side of the road, which is a second cousin to speeding.

In Rhode Island careful studies are being made of motorists' violations of the law in connection with automobile accidents. In 1,502 accidents during the first six months of 1929, the motorist was going "too fast for conditions" in 685 cases, or 45.6 percent of the total.

"So far as studies of accidents on the highways teach us anything," Dr. Dublin continued, "they show that speeding stands at the head of the list of causes responsible for the present situation which so greatly disturbs the American people.

"Another indication of the seriousness of the speeding habit lies in the fact that the number of accidents is mounting even faster in the rural areas than in our cities. Thus, in 1928. the large cities showed a rise of sixteen percent in the number of automobile fatalities above the rate of 1924, whereas, (Continued on page 144)

The motor cycle cop sneaks up to trail a speeding car. When speed laws are brought up to date, such hounding of motorists will cease; instead, the officers will direct their efforts against recklessness.

Now—The Automatic Pilot

Remarkable Gyro-Electric Mechanism Holds the Stick and Guides an Airplane on Its Course for Three Hours without Human Aid

OVER Ohio, the other day, a big tri-motored Ford plowed through the air on its way to Washington, D. C. Four men leaned back at ease in the passenger cabin. Yet the pilot's compartment was empty. A metal airman, scarcely larger than an automobile battery, was holding the stick.

Guided for more than three hours by this automatic pilot, the monoplane, carrying Lieut. Albert F. Hegenberger, famous California-to-Hawaii flyer, Major A. H. Gilkerson, and the co-developers of the invention, Elmer A. Sperry, Jr., and Capt. Shiras A. Blair, flew from Dayton, Ohio, to within a few miles of Bolling Field, Washington. The pilot, Lieutenant Hegenberger, merely had to set the course and watch out for other planes. At times, he was able to walk back and join his friends in the passenger cabin. The flight was the culmination of eighteen years of experiment, begun by the Sperry Gyroscope Company in 1912.

The "brain" of the remarkable mechanism—called the "Macaviator" by Army officers as a contraction of mechanical aviator—consists of two gyroscopes, one mounted horizontally, the other vertically and pointing straight ahead. These

The diagrammatic dotted lines indicate the installation of the mechanical aviator under pilot's seat.

heavy-rimmed wheels spin at 15,000 revolutions a minute. They are turned by electric current produced in a wind-driven generator mounted in the slip stream of the plane's propeller.

By the nature of the gyroscopes, they remain unmoved from their positions when the plane tips. If a wing or the nose dips, or the machine swings to one side or the other, the plane, in effect, rotates about the gyroscopes. A variation from level or straight flight of as little as one half of one degree results in making an electrical contact which, through the action of electromagnets, moves the controls and brings the plane back to its correct position. The horizontal gyroscope governs the ailerons and elevator. It keeps the wings from dipping and maintains a level keel fore and aft. The vertical gyroscope steers the plane.

The complete mechanism is small enough to fit under the pilot's seat. It can be connected or disconnected instantly by means of a small lever. The action of the device may also be terminated electrically by throwing a switch. Three additional levers permit the pilot to throw different parts of the apparatus out of gear at any moment. Thus he can resume control of the rudder or the ailerons or the elevator while leaving the rest of the operation of the plane to the automatic apparatus.

The sensitiveness of the robot in responding to movements of the plane is said to be superior to that of the average human pilot. The controls are moved so smoothly and firmly by the mechanism, it is reported, that a pilot cannot overcome the action with his hand.

The plane is governed by the automatic device only on straight, level flights. The aviator must take his machine off the ground as usual at the start and must land it at the end of the trip. But he is relieved of the long strain of piloting between distant points. The device is expected to prove of special value in transport work, on long bombing raids, and in "blind flying." In a fog, it will prevent a plane from stalling and entering a tail spin. It should also prove a great help in aerial photography. In this work, the plane must be kept at a constant altitude and on a straight line.

Before the Dayton-Washington flight, the apparatus had been successfully tested by nearly fifty hours in the air. It guided the large transport machine on trips between New Bedford, Mass., and Mitchel Field, Long Island, N. Y., and between Dayton and Detroit. The only adjustment required during these trips was altering the direction of flight when the wind changed. For, although the apparatus keeps the nose of the plane pointed straight ahead, a strong cross-wind will carry the machine sidewise.

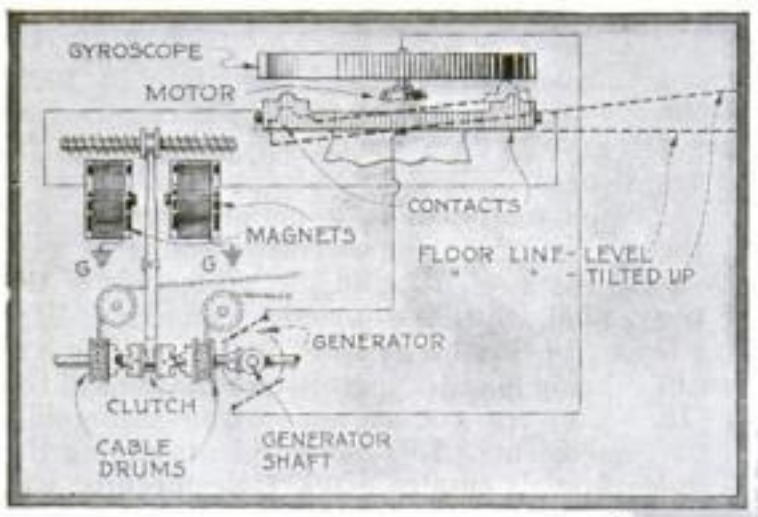
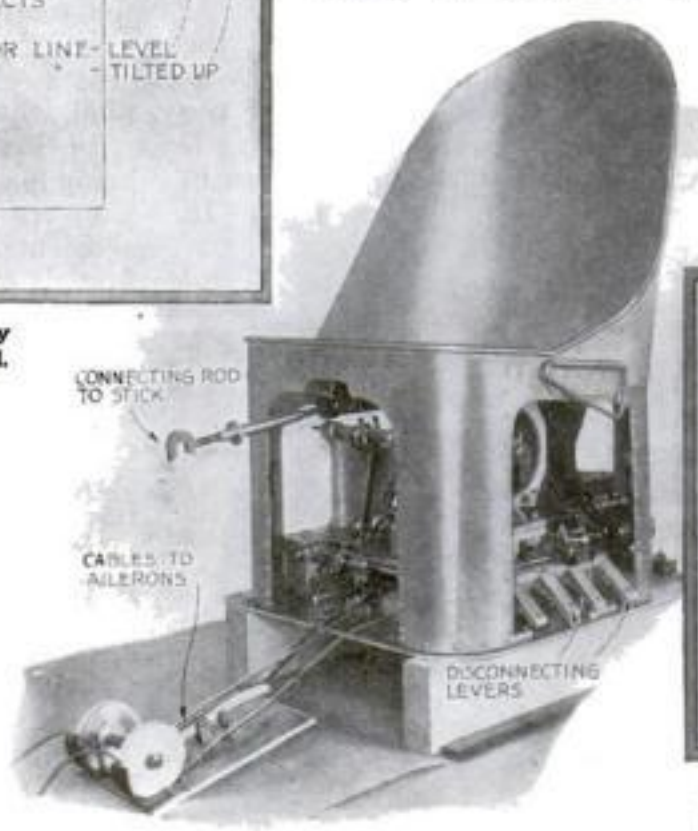
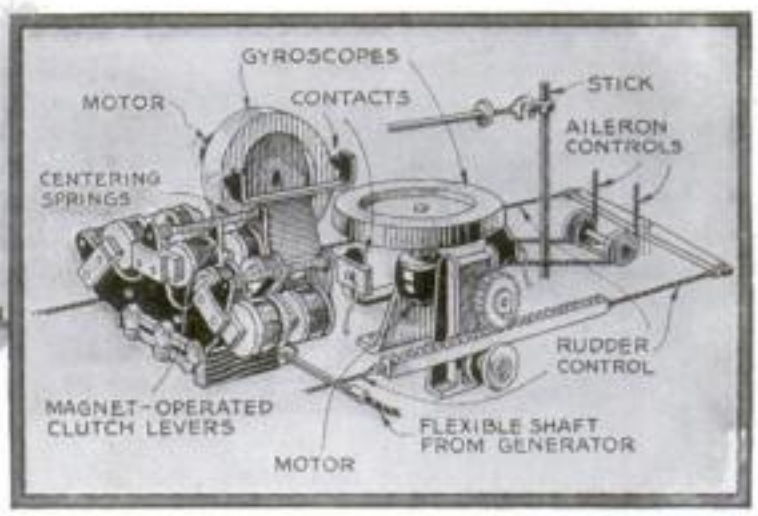


Diagram showing electrical control by which gyroscope keeps the plane level.





A pictorial diagram of the gyro-electric pilot, revealing how it operates the controls. At the left is a photograph of the device itself, which is hardly larger than a storage battery.

Latest Trends in Motorboating

Racing outboards—the second stage in the evolution of the "kicker." Now family runabouts and cruisers with sleeping accommodations are being powered with outboard motors.

New Inboard Runabouts, Outboard Cabin Cruisers, and Commuter Hydroplanes Meet the Demands for Sport and Speed on Uncongested Water Highways

By ALDEN P. ARMAGNAC

THE "flivver motor boat" is here. For the first time in motor boat history, a fast inboard "runabout"—meaning a small open craft for sport and errands—can be bought for the modest price of an outboard. An entirely new type of high-speed motor, light in weight and portable, that can be installed within the hull of a boat, has made it possible. Preliminary models of the new craft have appeared on the market only within the last few months. And it is still evolving toward its final shape.

That is the outstanding development in motor boats revealed in a survey of their trends conducted by POPULAR SCIENCE MONTHLY. It represents the latest step in meeting the demands of thousands of automobile owners who are finding roads too clogged with traffic for pleasure and are taking to the water. They want boats to go from summer home to market, boats even for daily commuting to the city. One of their particular wants—a cheap, dependable inboard motor boat for sport and pleasure—is now assured.

Advance motor boat fashions for 1930 show startling innovations, in both inboard and outboard types. Visitors to coming motor boat shows at New York, Boston, and elsewhere will see more elaborate outboard-motored craft than ever before; even cruisers with sleeping accommodations. Small but luxurious cruisers for wealthy commuters have been transformed since last year from single to twin-screw models for higher speed. Racing boats have been converted into high-speed runabouts for the public, through a change in the shape of their bottoms that makes for safety.

The new inboard motor boat had its beginning a few months ago, when an eastern manufacturer brought out a new portable type of inboard motor of twenty-five horsepower and weighing only 165 pounds. Unannounced to the public, several hundred of the new motors were tried out last summer in the outboard hulls of three manufacturers. Soon they appeared on the market in hulls previously built for outboards. Such boats sold for less than $1,000. In the first of them the motor was placed amidships, in the conventional way made necessary by the normal slant of a propeller shaft, splitting the passenger space in two. Then engineers tried putting it out of the way, in the stern.

Out of this idea has come the so-called "inboard-outboard" drive. The shaft of the inboard motor pierces the stern near the water line. In the place previously occupied by an outboard motor is now an arrangement that literally puts a "kink" in the power line, and drives the propeller through a vertical shaft and bevel gears or a similar system. Not only is the motor out of the way, but it may be placed absolutely level, insuring equal lubrication of all cylinders.

ONE of the first small inboard runabouts to use this system is a sixteen-foot craft priced at $985 complete with motor. A further improvement, that of hinging the inboard drive so that it will swing back and up without damage to the propeller if it hits an obstruction just as an outboard motor does, is being developed by several makers. It may become a standard feature of the future "flivver motor boat." Apparently this craft is to

be an inboard-outboard hybrid with the advantages of each.

Meanwhile the outboard makers have evolved the outboard cruiser. It is the last of a series of surprises in the years since Ole Evinrude brought out the pioneer one-cylinder "kicker." Originally this was intended merely to take the place of oars in a rowboat. But multi-cylinder models followed. When outboard motor boat races were first proposed a few years ago experts laughed at the idea. Even their champions were hardly prepared for the forty-mile speeds that followed, or for the amazing fact that an outboard motor could whirl its crank shaft at speeds as high as 6,000 revolutions a minute. Racing outboard craft that developed, built for speed alone, were appropriately dubbed from their shape "flying shingles." Last October, at Newport Beach, Calif., the fastest of them all made a new official speed record of 48.40 miles an hour.

NEXT came the "family type" outboards, designed especially for utility and pleasure. The latest of these are elaborate, inclosed models—sedan runabouts and cruisers with sleeping accommodations—made for outboards. They have gone even above the $1,000 price class. While inboard craft are extending their range to enter what was once the exclusive field of outboards, the outboards themselves are verging upon the luxury and appointments of the inboards. Even electric starters for outboard motors, a long-predicted development, are a feature of the newest models.

These are the boats that the average person of moderate means is interested in for pleasure boating and for knockabout transportation. But there is another, and a rapidly-growing class of users—the commuters of New York City, Boston, Cleveland, Detroit, Chicago, and the Pacific coast. During the summer these men live an hour or two by water from the city, and commute daily by motor boat—thus avoiding the jam of automobile traffic or the stuffiness of crowded trains. In New York alone it is estimated that there are more than a hundred such commuters. Some of them own beautiful fleets of fast boats, from forty to a hundred feet in length. They can make from twenty-five to fifty miles or more an hour, and cost from $25,000 upward.

BESIDES the crew required to run such a craft, the owner may take aboard his valet and his secretary. At his summer home he boards the boat clad in a bathrobe, and while it cruises along the shore he takes his morning shower and dresses while a steward prepares breakfast. After breakfast the owner may dictate correspondence to his secretary. After a cruise of an hour or two he steps off his boat at a yacht club dock to be whisked to his office by taxi or his private car. Going home in the afternoon he may take his friends along, serving refreshments or donning sport clothes for a game of golf or tennis before dinner.

Sometimes it is possible to reduce the individual expense of running a commuting boat. Six Boston men, for example, have incorporated under the Massachusetts law as "Commuters, Inc." They pooled their money, bought a boat, and hired a crew. Thus they can commute daily by water between Nahant, Mass., their summer residence, and Boston.

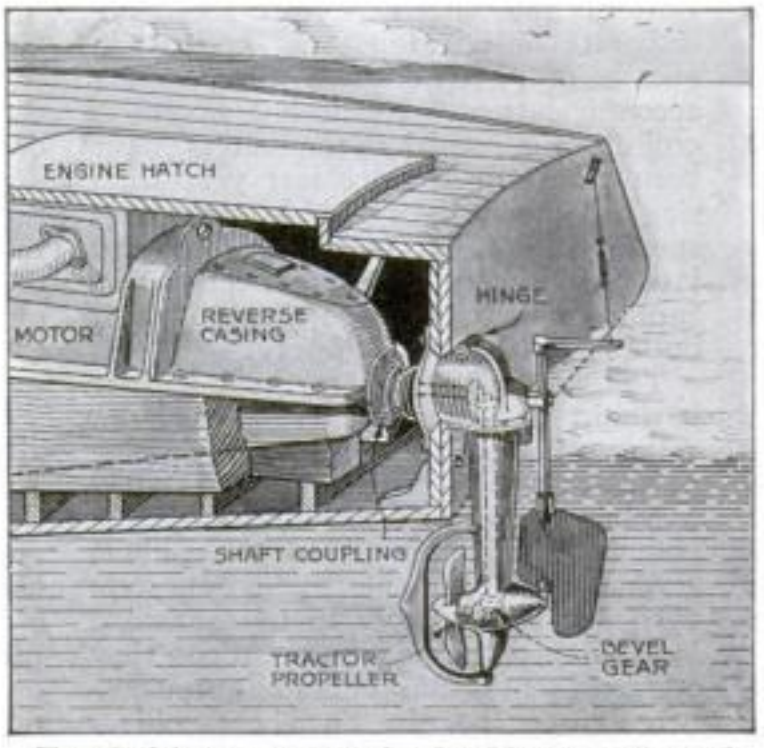
A real water "flivver"—new five-passenger inboard runabout, engine in stern. Costing $985, it drives like an auto.

Commuting boats are of the type known as "day cruisers." They are intended for daytime use and short week-end trips only, although they may have limited sleeping accommodations. Primarily they are speedy, and they are being made speedier. Here they have profited by the design of racing boats. Swift racing "hydroplanes" are built with a step or notch in the flat bottom, tending to lift the boat out of the water at high speed. A cushion of air trapped under the boat's hull permits high velocity by reducing the friction between the hull and the water. But flat-bottom racing hydroplanes are not adapted to ordinary use because they tend to be erratic and unstable at low speeds.

WITHIN the last two years, hydroplane design has been adapted to commuters and runabouts by modifying the shape of the bottom toward the conventional V-shaped outline of stepless boats. A New York manufacturer claims a speed of forty-four miles an hour for his forty-two-foot two-step hydroplane commuter powered with two 400-horsepower engines. A 400-horsepower thirty-six-foot runabout of similar design is credited with mile-a-minute speed. A thirty-six-foot single-step hydroplane equipped with an 850-horsepower motor, recently purchased by W. S. Corby, Washington, D. C., sportsman, for use at his summer home at Lake Winnepesaukee, N. H., is called the "world's fastest runabout." It can make nearly seventy miles an hour with two persons aboard.

A radical development in the opposite direction is the appearance of comparatively slow-speed commuters for week-end commuting. A recent example is the twelve-mile-an-hour Diesel commuting yacht *Alone* built for Harrison H. Boyce, New York City. The owner boards his yacht near his home, at its Montauk, N. Y., anchorage, about ten o'clock on a Sunday evening. A pleasant two-hour sail across the bay is followed by a comfortable night's sleep while the yacht cruises over Long Island Sound. Early Monday morning the yacht docks in New York, with adequate time for breakfast on the boat before office hours. During the week the owner may remain in New York, to return the following week-end. This yacht is luxuriously fitted, with hot and cold water, gas range in the galley using bottled gas, electric ice box, and even an electric fireplace in the forward inclosed cockpit which serves as a living room.

Among cruising boats with full sleeping accommodations, intended for long trips, new models are appearing with double instead of single cabins, one fore and one aft. The owner and his wife may enjoy peace and quiet in one cabin, putting the children in the other; or two couples can make a trip together in privacy and comfort.



How the inboard motor can be placed in stern. A geared drive outside the hull transmits power to propeller. The drive unit is hinged to swing up if it hits an obstruction.

ONE remaining development of particular interest is the motor sailer, the motor boat and sailboat combined. It is the outgrowth of the auxiliary sailboat, which originally was simply a sailboat with a motor of uncertain capabilities attached to drive it at low speed when the wind failed. Now such craft approach more nearly the lines of a motor boat while retaining their sailing ability.

Thus new types of boats, and hybrid craft combining the advantages of their progenitors, await the growing crowds that are taking to the water. Already Americans own 1,250,000 motor boats, and the number is increasing daily. For on the waves there are millions of miles of "clear road" ahead.

Obverse and reverse of POPULAR SCIENCE MONTHLY Gold Medal.

Announcing a $10,000 Annual Award

for the Most Valuable Achievement in Science

IN 1872, Edward Livingston Youmans founded POPULAR SCIENCE MONTHLY. A friend of Spencer, of Huxley, of Tyndall, this blind, self-taught scholar walked with the kings of science and retained his human touch. He spent his life opening a world of wonder to the many who lacked the benefit of technical training. He set out to make science popular. And he succeeded.

"The work of creating science has been organized for centuries. The work of diffusing science is the next great task of civilization."

With that slogan, he started POPULAR SCIENCE MONTHLY. It was to form a connecting link between the scientist and the public, between the laboratory and the layman. In understandable language it was to describe and interpret the seeming magic of the test tube, the microscope, and the machine shop.

For more than half a century, POPULAR SCIENCE MONTHLY has hewed to the line.

When its first issue appeared, rural delivery of mail had not begun, permanent bathtubs were just appearing in American homes, high wheel bicycles were still in vogue. In 1872, electric lights were unknown, the telephone was yet to be invented, the gasoline engine and the automobile were still in the realm of fancy. In the crowded years during which its pages have been recording the progress of invention and discovery, the typewriter, linotype, dynamo, automobile, airplane, submarine, radio, moving pictures, and skyscrapers have come to alter our civilization.

TODAY, millions know the everyday facts about these inventions. But science is stretching out in a thousand directions. Devoted workers are seeking the secrets of the sun, the air, the atom; they are plumbing the source of cosmic rays and striving for wireless transmission of power. They are tracking the causes of cancer, and analyzing the health-giving power of ultra-violet rays.

Science still holds almost unbelievable gifts for man.

The work which the founder of POPULAR SCIENCE MONTHLY commenced becomes more vital with every passing year. Sterilized foods protect our health; swift new means of transportation carry us from place to place; and fascinating forms of entertainment, unknown a generation ago, give us relaxation.

In the fifty-eight years of its existence, POPULAR SCIENCE MONTHLY has consistently striven to emphasize those advances which have proved of lasting practical value to the public. By so doing, it has encouraged scientific and inventive effort, helped to diminish drudgery, aided in increasing intellectual and material comforts, and assisted in providing the leisure to enjoy them.

IT IS particularly fitting, then, that POPULAR SCIENCE MONTHLY should take another step along the course it always has pursued.

In September, 1930, it will make the first annual award of $10,000 (ten thousand dollars) and the POPULAR SCIENCE MONTHLY Gold Medal to the American citizen who, in the opinion of the distinguished members of a Committee of Award, has been responsible for the achievement in science during the year of greatest potential value to the world.

The yearly period of scientific accomplishment considered by the Committee of Award will be the twelve months ending June 30, 1930. All scientific workers, professional and amateur, academic and commercial, are eligible for the prize.

The award, the largest single monetary prize in America for scientific accomplishment, is instituted with a dual purpose: to heighten the interest of the American people in those conquests of the laboratory and the workshop which benefit the whole community, and to focus attention upon the many scientific workers who toil to better man's control over his physical surroundings.

The award will be bestowed under the auspices of the Popular Science Institute, of which Prof. Collins P. Bliss, Associate Dean, College of Engineering, New York University, is Director. The Institute has enlisted twenty-four leaders in Science to serve as the Committee of Award.

THE COMMITTEE OF AWARD

DR. CHARLES G. ABBOT, Secretary, Smithsonian Institution.
PROF. COLLINS P. BLISS, Director, Popular Science Institute.
DR. SAMUEL A. BROWN, Dean, New York University and Bellevue Hospital Medical College.
DR. GEORGE K. BURGESS, Director, United States Bureau of Standards.
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DR. ALBERT E. WHITE, Director, Department of Engineering Research, University of Michigan.
DR. WILLIS R. WHITNEY, Director of Research, General Electric Co., Schenectady, N. Y.
ORVILLE WRIGHT, co-inventor of the airplane.

Fuel blown away—a typical gusher. When this Texas well blew in, 900 barrels of oil flowed in a single hour.

Better Fuels for Better Motors

By E. H. HAMILTON

Assistant Professor of Automotive Engineering, New York University

GASOLINE, many people are now discovering, is not just a smelly liquid that must be pumped into the auto tank at periodic intervals. Different gasolines may look alike. They may even smell alike and yet be as different in performance as a tugboat and a Gold Cup racer.

In fact, the introduction of improved types of motor fuels by all of the up-to-date refiners has opened a new era in the development of the automobile and in the pleasure of driving it. Knocking, for instance, once the mysterious bane of motorists and the principal limitation on improved engine design, is slowly being mastered.

The story of this accomplishment concerns one of the most fascinating battles which the modern industrial chemist has waged. But it is only one phase of the unceasing struggle to produce new and better fuel for the millions of motor cars which have become a part of modern life. To understand this struggle first requires an answer to the question: What is gasoline, anyway?

Gasoline is really a family name for a whole group of different hydrocarbon compounds. And these, in turn, are but a small division of a still larger group that forms what is known as crude petroleum. The latter is a vile-smelling, dark colored, thick liquid found in pools far underground. Judging by the appearance of the sticky stuff it hardly seems possible that a product so clean and clear as gasoline could be obtained from it.

Crude petroleum was produced ages ago in Nature's own laboratory, much as coal was formed. It is a product of the decomposition of vegetable and animal matter.

In 1859, Edwin L. Drake, a conductor on the New York, New Haven and Hartford Railroad, organized a company and drilled the first American oil well near Titusville, Pa. Petroleum was struck at sixty-nine feet. It was pumped from the well at the rate of twenty-five barrels a day. By the end of the year, this had dwindled to fifteen. But the modern oil industry had been founded.

Kerosene, or "coal oil" as it was then called, had just begun to supplant whale oil as the standard fuel for lamps. The supply, largely skimmed from the surface of ponds, could not keep up with the increasing demand. Drake's well offered a solution to the problem and other wells followed in quick succession. The first of the world's oil booms began.

Today, in the United States alone, more than 2,000,000 barrels of oil are produced daily by 280,000 wells, some of them a mile deep. During the twelve months of 1928, 12,500 new producing wells were brought in. So far, North America has proved the great oil reservoir of the world. At the end of 1927, more than two thirds of all the petroleum taken from the earth had come from fields in the United States and Mexico.

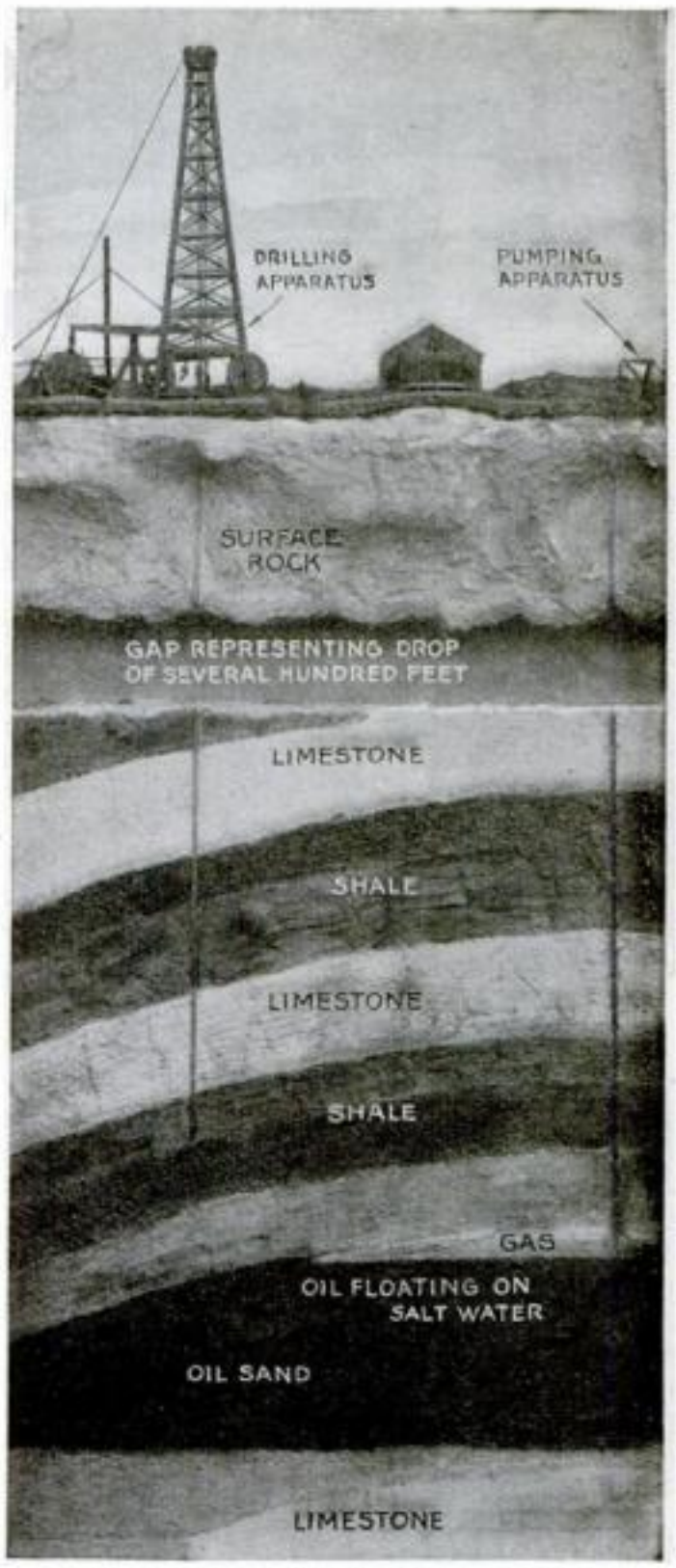
All petroleum contains various compounds of carbon and hydrogen. They can be separated by distillation. The boiling point of each compound is slightly different from that of the others. The difference between gasoline and kerosene, for example, is mainly one of the temperatures at which they boil. The gasoline boils off first. The temperature has to be raised before the kerosene boils off. By carefully regulating the temperature at which the liquid is being distilled, a practical separation of the carbon and hydrogen compounds can be made. However, there are so many compounds and their boiling points are so close together that any one fraction of the distillation always contains several different closely allied compounds.

CURIOUSLY enough, the fact that crude petroleum contains a large percentage of gasoline was looked on as a misfortune in the early days of the oil industry. Nobody knew what to do with gasoline—no practical uses for it had been developed—and in consequence enormous quantities of it were thrown away. Many refineries dumped it into the nearest river until laws were passed to stop this practice because of the fire risk.

Undoubtedly early forms of internal-combustion engines were designed to use gasoline rather than other possible fuels because gasoline was so cheap and easily obtained. A number of refineries gave it away free. Others sold it for a cent a gallon. They had no use for it. Contrast that situation with the present, when 1,000,000 barrels of gasoline are consumed every day. When nobody wanted

Inserting film in a new underground movie camera which aids in oil well drilling. Lowered into a well, it records position of a level bubble and compass needle, thus showing whether the well is being drilled in a vertical line. Note pressure-proof case in which cylindrical camera fits. Right: Photo taken by camera.

Here Are the Facts about Present-Day Gasoline Every Car Owner Wants to Know—What It Is, Where It Comes From, and How Science Produces and Improves the Million Barrels Consumed Daily



Model of an oil field, showing how a well is drilled, how one already bored is pumped, and arrangement of the various strata of earth above the oil deposit.

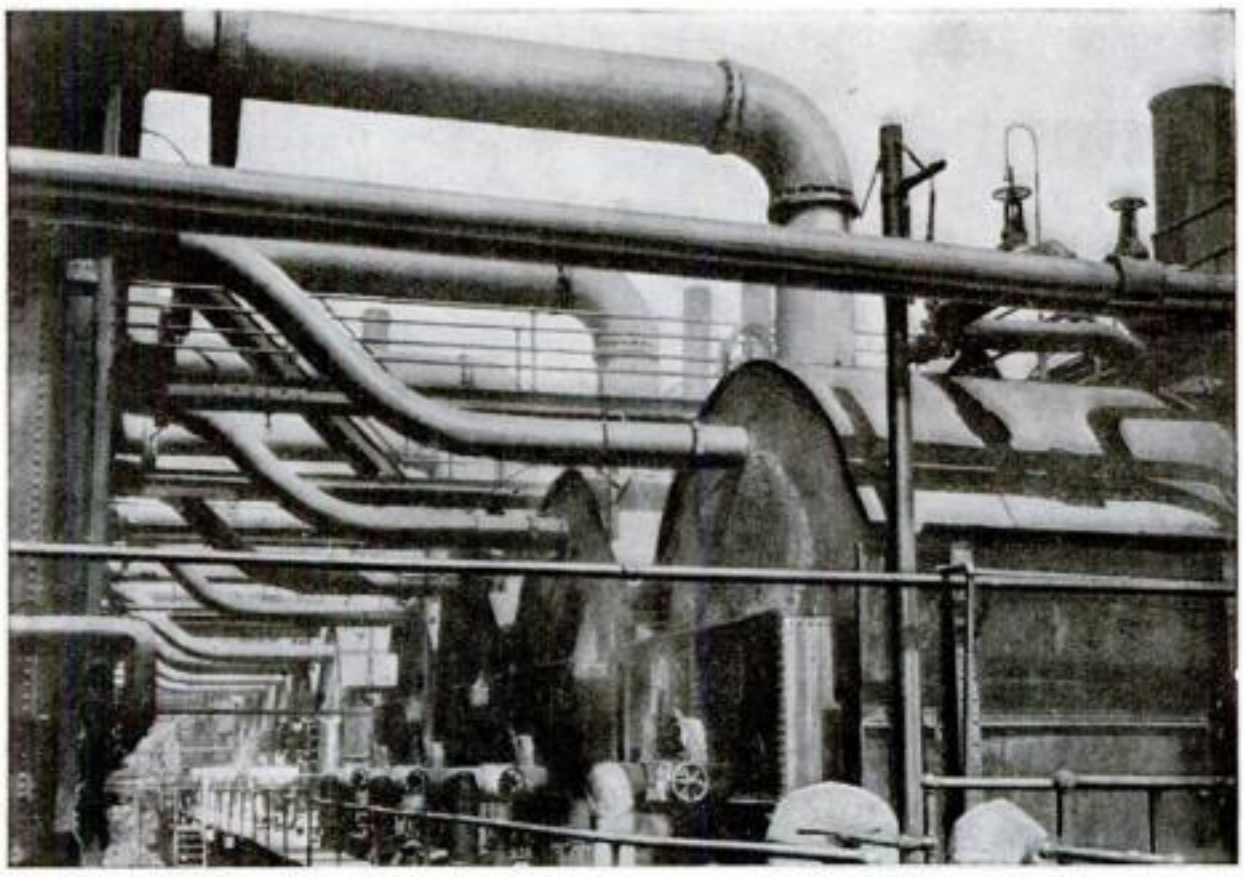
gasoline, it could be had for nothing; now, when everybody wants it, a dollar usually buys less than five gallons. The same law of supply and demand has been the spur which forced all sorts of engineering developments and improvements for the economical refining of crude petroleum.

WHEN automobiles were first introduced, all gasoline was high "test." Every bit of kerosene was removed from it because the refiners could sell kerosene for a good price. The motor fuel of those days was highly volatile and cars started easily in cold weather. This is the characteristic which now distinguishes the modern fuel labeled "high test" from the ordinary run of gasoline. "Aviation" gasoline is of exceedingly high volatility, providing quick ignition and high power. In the first automobiles there was no crank case dilution, or mixing of unburned gasoline with the oil, reducing the viscosity of the lubricant. The normal heat of operation was sufficient to drive the highly volatile gas of that period out of the crank case oil.

As the number of automobiles increased, the demand for gasoline did likewise. Refiners found that they had to include more and more of the kerosene-like constituents in the gasoline. Motor fuels, in consequence, became poorer and poorer. In fact, were it not for a remarkable improvement in the method of obtaining gasoline from crude petroleum, which has been introduced in the last few years, motorists would now be operating autos on practically pure kerosene with large percentages of furnace oil thrown in.

This great improvement is known as the "cracking" process. It makes possible the conversion of kerosene and other heavier constituents of crude petroleum into gasoline. The most used method of "cracking" was developed by William M. Burton, a chemist of the Standard Oil Company of Indiana. In theory, the cracking process is relatively simple. In practice, it is somewhat elaborate because of the delicate control of both temperature and pressure which must be maintained to achieve maximum results.

Any housewife who burns the steak or scorches the toast is delving into some of the manifold variations of the "cracking" process. Beefsteak and toast, like gasoline, are hydrocarbons, though they contain certain percentages of mineral matter. Any hydrocarbon, if subjected to sufficient heat, will be broken apart or, in other words, "cracked up" into other forms of hydrocarbon compounds or under certain circumstances even into pure carbon. The steak when it is burned is converted into carbon and certain hydrocarbon gases, some of them having the characteristic odors which convey, by way of the housewife's nose, the information that the dinner is not going to be a success. Similarly, the smell of burning toast denotes the cracking of the hydrocarbon in the bread into pure carbon and various forms of evil-smelling gases.



Huge crude oil stills in the refineries of the Standard Oil Company at Cleveland, O. Here heat is first applied to the oil in the process of separating its various components, including gasoline.

By subjecting the portions of crude petroleum to high temperature, and at the same time to high pressure, it has been found possible to "crack" or break up the kerosene constituents and a portion of the still heavier compounds directly into gasoline. Today almost half of the gasoline marketed is produced by cracking.

THESE improved methods have maintained the price of gasoline at a reasonable level. They have also proved of great importance to the gasoline engine designer and consequently to every motorist. This is because they have tended to standardize the quality of motor fuel. Gasoline is not a single, definite, invariable chemical compound. It always is a mixture of several different compounds and its characteristics vary in consequence. Gasoline produced from crude petroleum obtained in one part of the country will not have exactly the same characteristics as gasoline obtained from another part of the country, and gasoline produced (Continued on page 139)

Solve Riddle of Egypt's "Man Queen"

The kneeling, bearded statue of Queen Hat-shepsut, rebuilt from fragments.

BY SOLVING a mystifying archeological jig saw puzzle, members of the Egyptian expedition of the Metropolitan Museum of Art, New York City, have reconstructed for the first time shattered statues of a feminine pharaoh who ruled Egypt with an iron hand 3,400 years ago. As the result of important excavations they have unfolded a drama of ancient wrath and intrigue that once sought to obliterate all memory of the tyrant queen from the land of her people.

Queen Hat-shepsut was her name. At the death of her husband, she usurped the throne in disregard of the heir apparent. She proclaimed herself king, and ordered court sculptors to hew her likeness in masculine garb and adorned with a beard as symbols of her might. Scores of these statues she used as decorations for the great temple of Deir el Bahri, which she erected on the west bank of the Nile, in Upper Egypt, across the river from Thebes, her capital city.

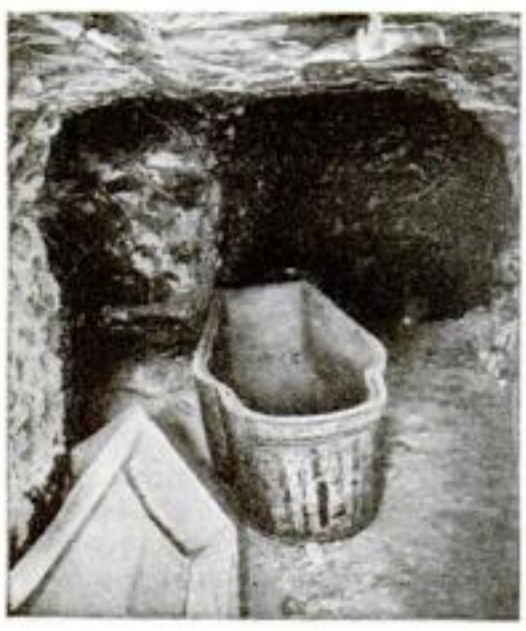
When, in 1479 B.C., Queen Hat-shepsut died—under suspicious circumstances, according to some Egyptologists—King Thut-mose III, her husband's son by a so-called "minor wife," whom she had suppressed since boyhood, gave vent to his hatred. Not a trace of her memory, he vowed, should remain in the minds of gods and men. First, he had all inscriptions of her name scratched from the temple. Then he commanded that her statues should be smashed and the fragments scattered to the four corners of the earth. His minions did a good wrecking job, but the pieces they dumped into a near-by quarry.

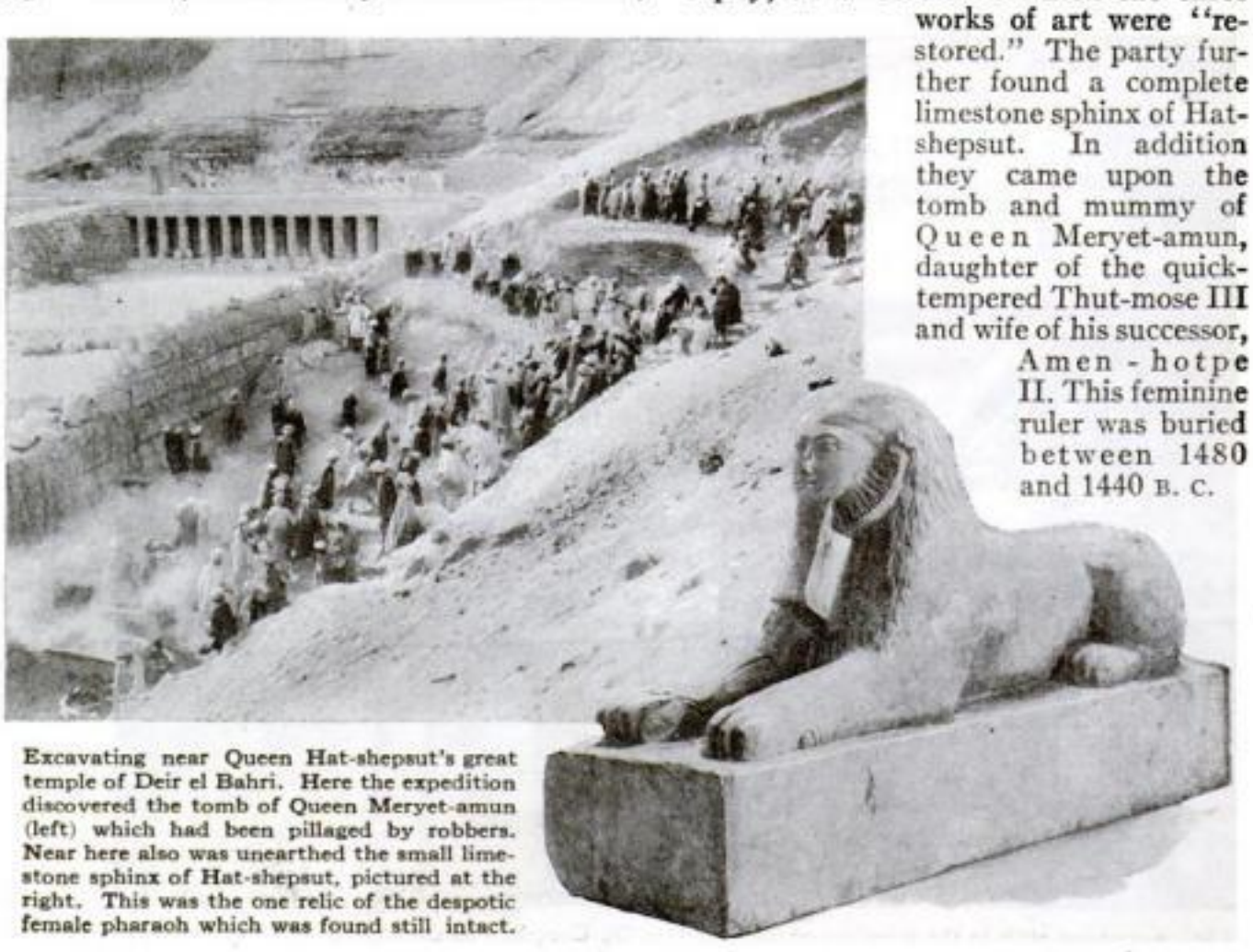
Last winter members of the Metropolitan Egyptian expedition unearthed several damaged pieces of these stone portraits. And with these findings, together with fragments previously found, it became known the other day, Herbert E. Winlock, director of the expedition, has been able to piece together three of the aggressive lady's likenesses.

In itself, the discovery of the fragments was no novelty. Sir John Gardner Wilkinson, English explorer and Egyptologist, had found some as early as 1827. Eleven years later, the French scientist, Nestor l'Hôte, sketched and described at least one of them. In 1843 and 1845 Karl Richard Lepsius, noted German archeologist, brought parts of one statue, including the torso, and the head of another, as well as the head of a sphinx with the Queen's features, to Berlin, where they were placed in the State Museum. And in 1869, Prince Henry of the Netherlands, visiting Egypt on the occasion of the opening of the Suez Canal, obtained two broken pieces of ancient statuary, which he took back to Holland as souvenirs. One of these was a torso of Hat-shepsut.

Granite sphinx of queen. The head, found years ago, matched the newly found body.

The first fragments unearthed by the Metropolitan expedition formed, when put together, an exquisitely sculptured head of the Queen. Further search yielded a sphinx without a head. Soon afterward, another head was found. Winlock then made a flying trip to Holland and Germany and found that his expedition had discovered the head belonging to Prince Henry's torso fragment, the body of Lepsius' sphinx head, and the head of the latter's kneeling figure of the Queen. Returning to Egypt, he and his assistants conducted an interesting experiment in trick photography, as a result of which the three works of art were "restored." The party further found a complete limestone sphinx of Hat-shepsut. In addition they came upon the tomb and mummy of Queen Meryet-amun, daughter of the quick-tempered Thut-mose III and wife of his successor, Amen-hotpe II. This feminine ruler was buried between 1480 and 1440 B. C.





Excavating near Queen Hat-shepsut's great temple of Deir el Bahri. Here the expedition discovered the tomb of Queen Meryet-amun (left) which had been pillaged by robbers. Near here also was unearthed the small limestone sphinx of Hat-shepsut, pictured at the right. This was the one relic of the despotic female pharaoh which was found still intact.

"Patterns"—The New Psychology

Dr. A. P. Link, instructor in psychology in New York University, with apparatus designed to elicit evidence of a crime. The small disks before Dr. Link and the subject are connected with an instrument which measures the time between a question and the reply.

An Authority Describes the Latest Theory of "Gestalt," Comparing It with Freudian and Other Ideas of Behavior

By A. T. POFFENBERGER
Professor of Psychology, Columbia University

PSYCHOLOGY is the science of running things. Driving an automobile, piloting an airplane, building a house, writing a book, constructing a machine, winning a war, making a success out of a business; all these are compounded out of human thoughts and actions. Thinking and doing; these are the materials of life on earth. To explain both is psychology's job.

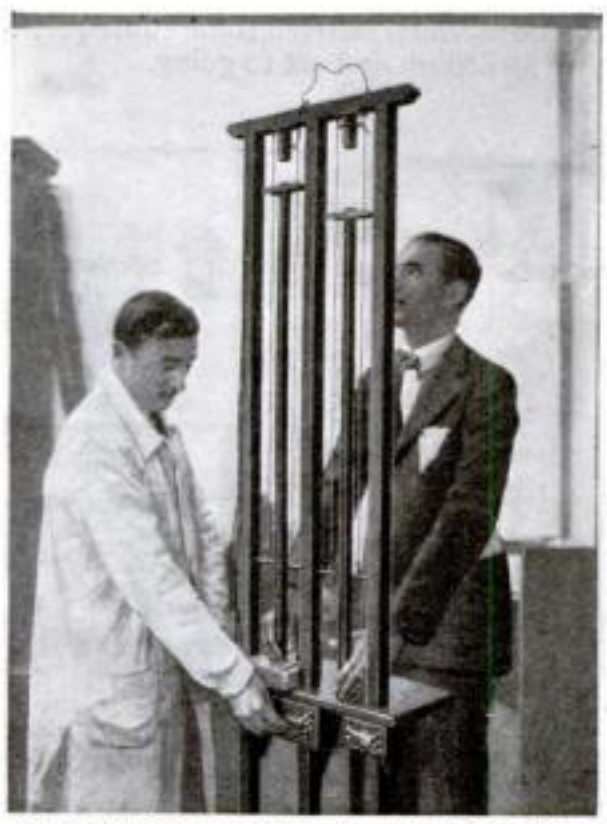
Within one generation there have been three prominent sets of psychological theories. Not so long ago psychologists were explaining everything that human beings did or thought as due to a mysterious something called reason, as one explains the movements of a battleship by orders from the captain in the conning tower.

Some psychologists perceived, however, that people often did utterly unreasonable things, like committing murders in a fit of rage, or investing in stocks known to be valueless. Such clearly unreasonable acts and thoughts were blamed on emotions or impulses. On one form of this idea has been built the theory of psychology associated with the name of Freud.

Next came the behaviorist psychology, chiefly urged by Dr. John B. Watson, formerly of Johns Hopkins University. To the extreme behaviorist a human being is little more than a bundle of actions and reactions, to be studied much as a mechanic studies the workings of an automobile engine, or as a biologist studies the behavior of a white rat in a cage. As a critic has said, "Behaviorists forget that a man is sometimes conscious."

Finally, within the last few years has come still a newer set of theories, the so-called "Gestalt" psychology, or psychology of patterns, for "gestalt" means pattern in German. Small wonder, among these conflicting theories, that many laymen and even some psychologists get confused and imagine the whole science in a state of continual explosion.

That is not true. The supposed "revolutions" in recent psychology have been like chips tossing about on the surface of a river, while the steady stream of careful scientific investigation has flowed on unceasingly beneath.

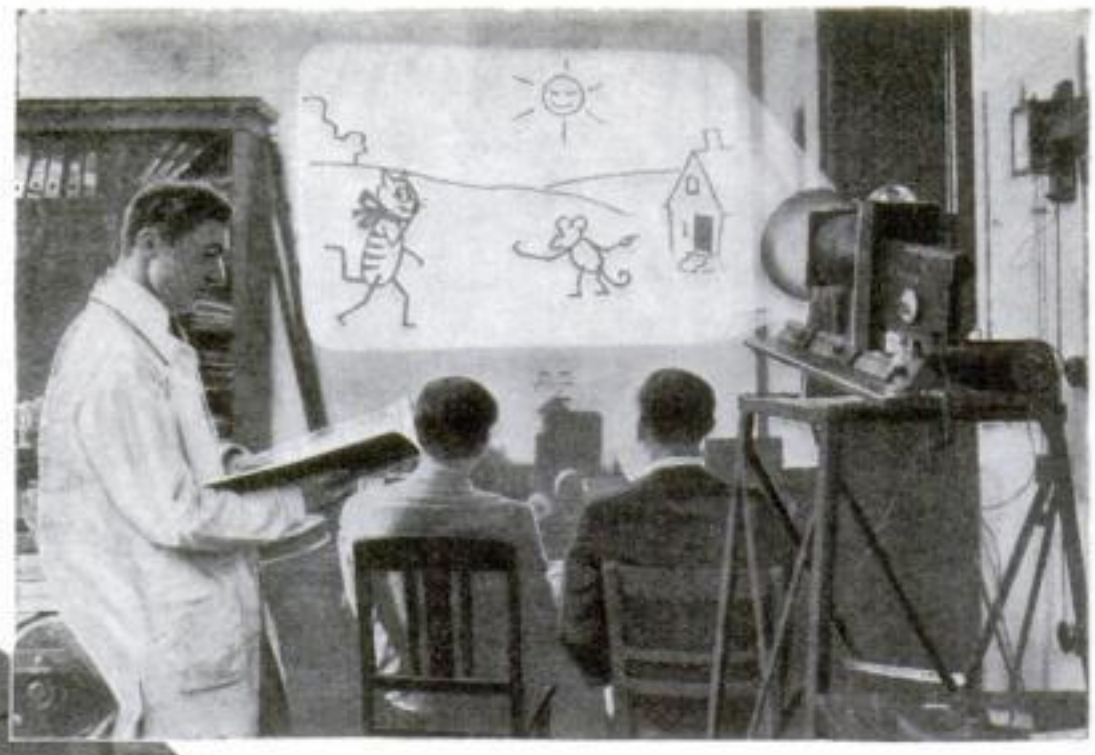


Psychological apparatus to test the observation powers of applicants for clerical jobs.

THE newest Gestalt psychology, for example, has grown from facts gradually discovered in the course of years by the study of senses like sight and hearing, and may be most easily illustrated by some facts about optical illusions.

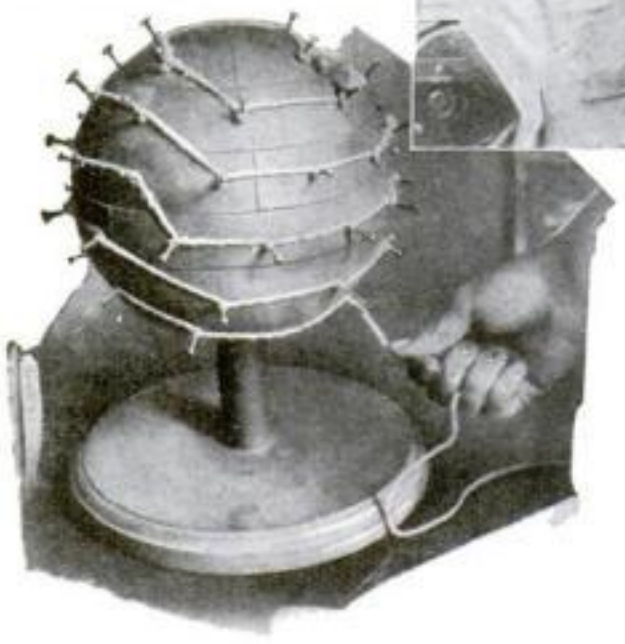
If the printer of this magazine, for example, accidentally left out one letter of a word in this sentence, many readers would not perceive the misprint. They would supply the missing letter mentally; for most adults and many young children read whole words as single eye-patterns, not each letter individually. In music, a melody is recognized as the same regardless of the particular key in which it happens to be played. The average ear perceives no difference because it is the *pattern* of the tones that is heard and not the separate tones individually.

Even the cartoons in the Sunday newspaper are examples of how almost everybody uses unconsciously this perception of patterns or "gestalts." Faces and bodies of the cartoon characters are



A test of concentration. The subjects are required to follow and grasp the meaning of words read by a lecturer standing behind them while they watch a motion picture.

Cleverness in handiwork is tested by the speed and skill with which the subject can connect and tie with string the nails placed at intervals on a revolving ball, seen below.



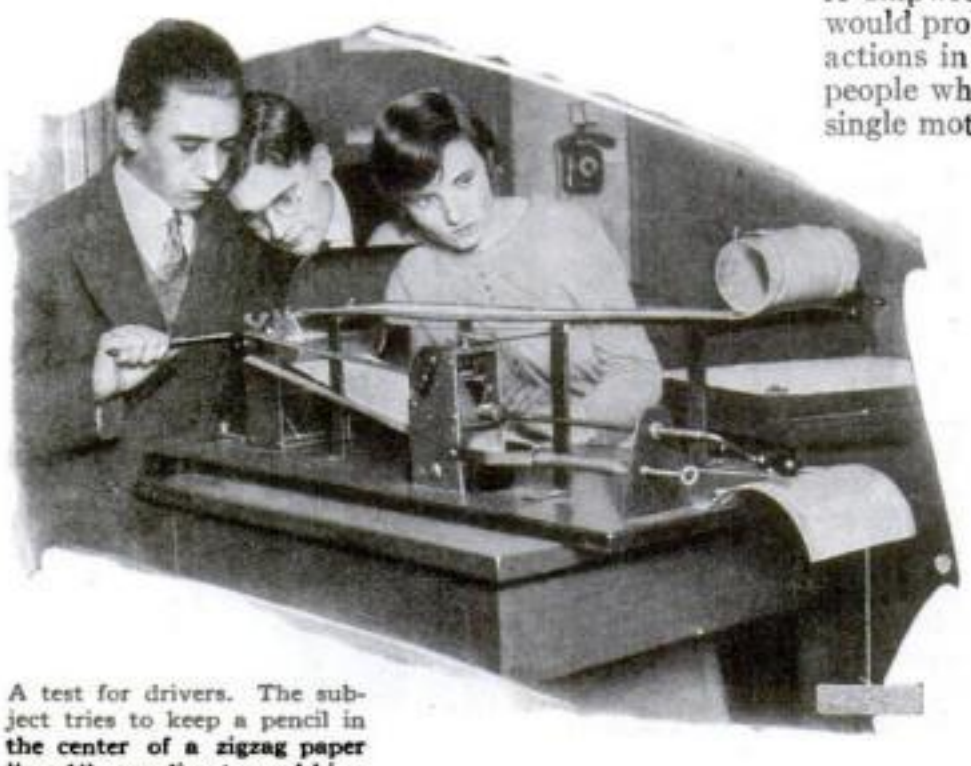
grossly distorted by the artists. An actual man who looked exactly like Andy Gump or little Jeff would be worse than a side-show freak. Even whole parts of faces or bodies can be left out of the cartoons without making these familiar characters unrecognizable. The eyes or the minds of habitual readers immediately supply the lack. Everything is ordinarily perceived all of a piece.

THE Gestalt psychology, chiefly urged by the distinguished German students of psychology, Dr. Kurt Koffka and Dr. Wolfgang Köhler, takes as its central conclusion the idea that this automatic completing of patterns and recognition by patterns is a universal habit of the mind, not merely of the senses. The whole of any habitual sight, sound, or idea is perceived, this theory says, when a sufficient part of it is supplied.

If this new viewpoint proves to be generally valid for complicated ideas and mental states, as well as for simple things like cartoons and musical melodies, its practical importance probably will depend upon its suggestions about how people learn new ideas or acquire new habits. This learning, the Gestalt psychologist says, is not by the laborious, unit by unit method in which the average child learns the letters of the alphabet. Instead, more or less complicated patterns are learned each as a complete whole, just as many children nowadays learn to read by whole words instead of by letters. The whole picture of CAT, for example, means the animal; not the combination of separate pictures of C and A and T.

This means, of course, that what one has learned must control one's entire set of perceptions, thoughts, mental characteristics, and actions. Only people who have learned the English-language meaning of the pattern CAT will assign that meaning to it. To others it will be meaningless or will mean something else. To an average American newspaper reader, one half of the face of Mutt or Jeff suggests the whole. To an African savage who never saw a newspaper, such halves of distorted human faces might suggest anything, or nothing.

An extreme interpretation of Gestalt psychology would seem to say that everything depends upon what set of patterns of life or thinking one happens to have learned; for the idea is presumably as applicable to morals, religion, and social customs as to the perception of patterns learned by ear or eye. To explain impulsive, unreasonable acts such as violent crimes or foolish promises the Gestalt psychologist would not blame overpowering emotions or poor reasoning powers, but would merely assume that the victim of such temporary unreason happens to have learned a wrong pattern of thought or action, which pattern some subsequent event called up and set to going.



A test for drivers. The subject tries to keep a pencil in the center of a zigzag paper "road" speeding toward him.

This conception of human nature may easily result, as many of its predecessors have done, in suggesting experiments and aiding the steady advance of psychology.

Gestalt psychology may seem at first to be merely an elaboration of the behaviorist theory. Actually it is a contradiction. Behaviorism asserts that certain definite stimuli cause certain definite reactions—that a lunge of a fist towards a subject's face causes him to wince, for example. Gestalt says that the reaction depends on the circumstances under which the stimulus is applied and the conditions of the organism to which it is applied—the whole pattern, in other words, rather than one stimulus. Thus the lunge of a friend's fist causes a different reaction than that of a stranger.

THE psychology of Professor Sigmund Freud, of Vienna, first of the new psychological viewpoints of recent years, may be described as a simplified and intensified version of the much older idea of impulses. Professor William James and other psychological leaders of the last century thought of man as moved by many impulses, like a clockwork mechanism with many different springs. A favorite phrase of that time, indeed, was "springs of human action." Such impulses or "motives" were listed in large number: selfishness, honesty, ambition, indolence, generosity, patriotism, and so on. Psychologists busily searched out hundreds of these different motives.

One of the great services of Dr. Freud is that he perceived the impossible complexity of this search, and strove to reduce those many mysterious springs of human action to a smaller number. In the end, he concluded that only one fundamental spring was necessary to make the mind go round. That single mainspring he found in the impulses of sex.

This particular selection, however, is no real necessity of Freudian psychology. A shipwrecked sailor on a desert island would probably find the mainspring of his actions in the desire for food. There are people whose whole lives seem guided by single motives of religion, patriotism, scientific research, or something else impersonal. Freudian theorists by no means ignore these examples of apparently sexless motives, but ascribe them to the forces of sex emotions which have been "sublimated" or turned into other, less personal, channels. One of Dr. Freud's former pupils, Dr. Alfred Adler, who now represents a conflicting psychoanalytic school, selects as his choice for the single motive or "mainspring" the desire for self-expression. Every human being, he holds, is born with

(Continued on page 137)

Plan Overland "Flying Hotels"

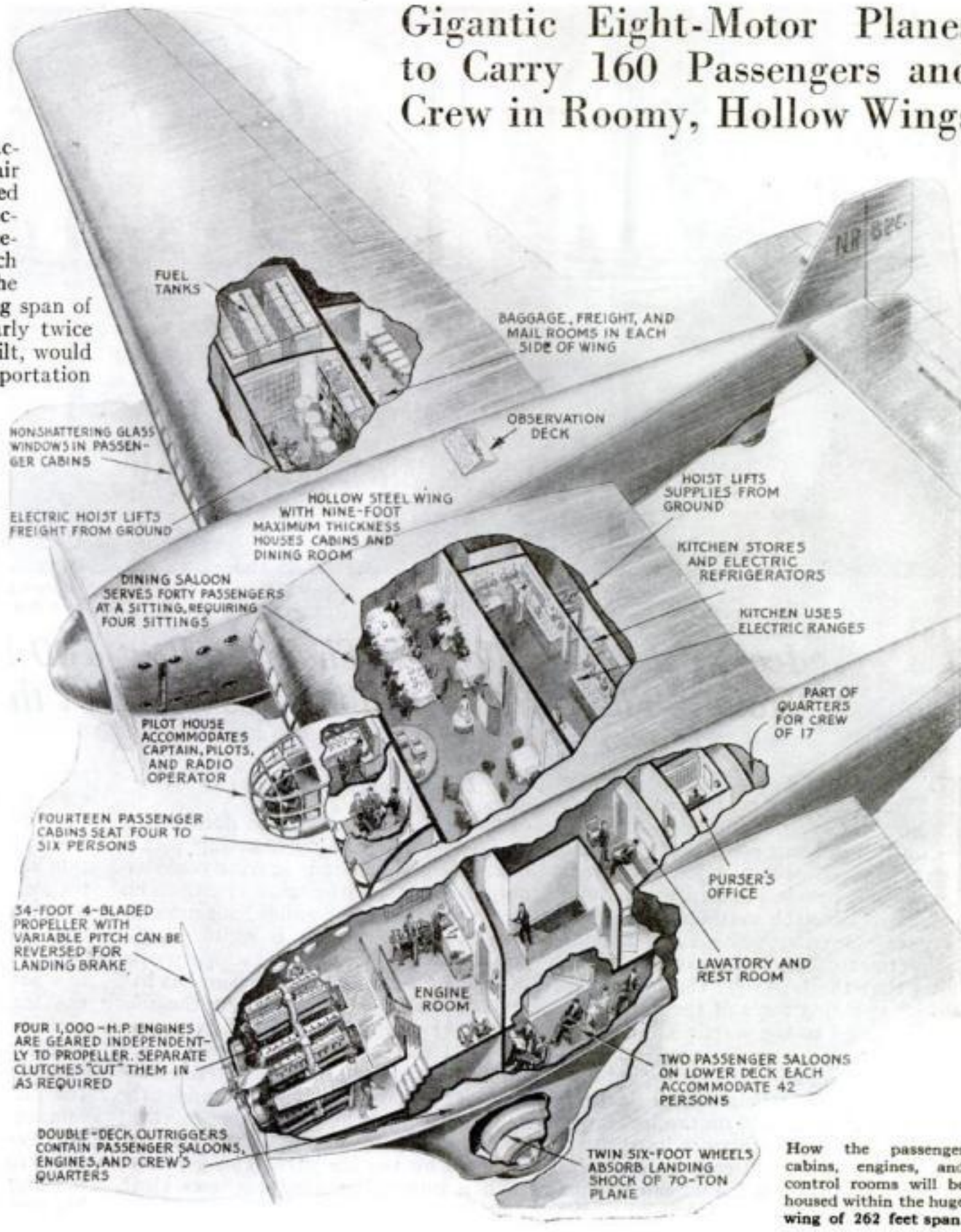
Gigantic Eight-Motor Planes to Carry 160 Passengers and Crew in Roomy, Hollow Wings

By

JOHN E. LODGE

"FLYING hotels" with accommodations for 160 air passengers are planned for American airways, according to the recent announcement of a Connecticut firm which projects their construction. The monster land planes, whose wing span of 262 feet would make them nearly twice the size of any airplane ever built, would be used for cross-country transportation in competition with railroads. Four of the ships are scheduled to take the air by the latter part of 1930. Others are to follow.

In the accompanying drawing the artist presents his conception of such an airplane, based on the plans of its designer, Dr. William W. Christmas, a pioneer in aeronautics, who claims to have been the first man after the Wright brothers to fly a powered airplane in the United States. To give some idea of the dimensions of the proposed craft, it is said that traffic on a wide city thoroughfare could pass unhindered between its landing wheels.



How the passenger cabins, engines, and control rooms will be housed within the huge **wing of 262 feet span.**

THE hollow wing, measuring nine feet from top to bottom at its thickest part, will contain passenger cabins and dining saloon. Two double-deck, fuselage-shaped outriggers will contain the engines and quarters for a crew of seventeen, with room to spare for two passenger saloons. Each saloon will seat forty-two persons, while the remainder will be in cabins along the leading edge of the hollow wing. Seats in the cabin can be transformed into sleeping berths.

Sitting in the saloons or cabins of the ship will be much like occupying a seat in a hotel lounge or a Pullman train. Muffled exhausts and the remoteness of the engines will tend to prevent noise and vibration. On two open-air observation decks atop the outriggers, passengers may sit behind windshields.

Engines totaling more than 8,000 horsepower, in the interior of the plane, are planned to drive the seventy-two-ton craft at a maximum speed of 145 miles an hour. Sufficient fuel will be aboard for an eight-hour flight at this speed. The airliner will have a maximum altitude or "ceiling" of 15,000 feet.

Banks of four engines will operate each of the thirty-four-foot, low-speed propellers through a novel arrangement that will permit any motor to be "cut" in or out independently of the others. For cruising speed six of the eight engines will be used, and for short periods it is expected that as few as two of the engines will be sufficient to maintain altitude.

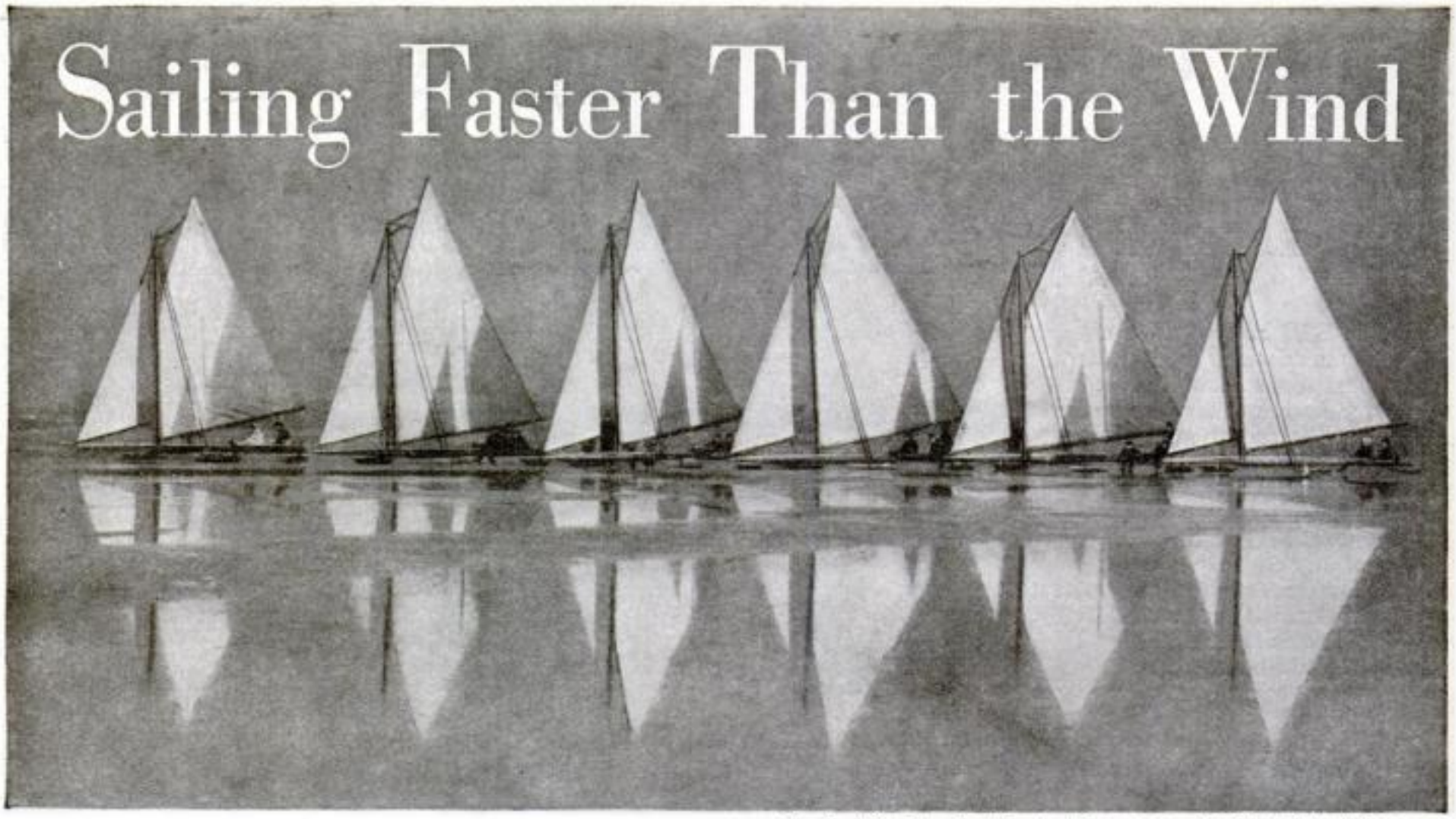
THE possibility of cutting out a disabled engine will facilitate easy repair in flight. All engines are to be chemically cooled at a saving of one third the weight of a system using a radiator and water for cooling. The pitch of the propellers will be adjustable in flight for most efficient operation, and the blades can be reversed to serve as a brake in landing.

Squarely in the center of the wing span will be the pilot house where the captain, pilots, and the radio operator will be on duty. There vision in all directions, including above and below, will be assured by an encircling shell made of panes of shatter-proof glass. Directly in front of the pilots will be the controls and navigating instruments. The airliner's master and radio operator will share the rear part of the pilot house, which will be in constant communication by telephone with the engine rooms.

Electricity from engine-driven generators will operate electric stoves and refrigerators in the kitchen, electric hoists for loading freight and food supplies from the ground, and the radio telephone and radio beacon apparatus. Exhaust heat will warm the interior of the plane, through a waste-heat boiler that will circulate hot water to radiators. Heat also will be used to prevent formation of ice on wings and propellers.

Heat-treated alloy-steel tubing and plywood covering will be the construction materials. Each plane is expected to cost about $2,000,000.

Sailing Faster Than the Wind



Ice boats lined up for the start of a race on the Shrewsbury River near Red Bank, N. J. Within a few seconds the yachts gain terrific speed.

Ice Yacht Pilots Match Their Skill at 100 Miles an Hour—The Speediest Motorless Sport in the World

By BARROW LYONS

IT IS a bleak wintry day on the Shrewsbury River in northeastern New Jersey. A cutting wind sends flurries of snow scudding across the open expanse of black river ice. Hundreds of cars, and people bundled in furs and mackinaws, line the southern shore. An array of wavering white sails, moving slowly toward the center of the river, shows that the boats for the championship ice yachting races of the season are being dragged to the starting line. Two men are clinging to each boat—a helmsman and a sheet trimmer. The wind tugs at their craft, but long spikes on their shoes give them a hold on the ice. Soon the birdlike little yachts are lined up.

A pistol sounds and each crew shoves off. After a few steps the trimmer jumps in and makes fast the sheet. The sails stiffen, the craft heels over in the strong, quartering wind, and the helmsman jumps into the cockpit. In a few seconds the yachts have gained terrific speed.

Speed is the thing in ice yachting. Before there were automobiles and airplanes, it was the fastest sport in which man indulged. Commodore James B. Weaver, of the Red Bank (N. J.) Ice Yachting Club, dean of ice yachting in America, claims that his *Scud II*, a lateen-rigged yacht, still holds the speed record for all time, having traversed a measured course of one and one quarter miles in the startling time of forty-two seconds in January, 1885; slightly more than 107 miles an hour.

When an ice yacht darts over the glassy surface of a lake, river, or bay it seems to its crew hardly to touch the ice—but rather to soar through the air. The closeness to the surface enhances the illusion of tremendous speed just as does skiing. In fact, when the ship is sailing with a quartering breeze, it is moving considerably faster than the wind itself. This may seem to be impossible, but actually the physical principle is quite simple. Any one who has pursued a slippery cake of soap across the bathroom floor has had an excellent demonstration of the mechanical action involved. The wet soap slips out of the hand with lightninglike rapidity although the fingers do not close together at any such speed. Consider the cake of soap as the sail of the ice yacht and the fingers as the wind, and the reason why the ice yacht can go faster than a quartering wind becomes clear. Like the cake of soap, the sail of the ice yacht slides away from the pressure of the wind, in a similar cam action, and when the sail is close-hauled so that it makes only a slight angle with the center line of the ship, the motion of the ship is magnified just as is the motion of the cake of soap by its gently sloping side.

In piloting an ice boat the slightest twitch of a muscle controlling the direction of movement is amplified in exact proportion to the speed at which the boat is traveling. The thrill far surpasses that of a sailing yacht because the motion is so much more rapid. The lead of a mile in a boat race is nearly fatal, as a rule, to the trailing craft, but in ice yachting, with boats able to make forty to one hundred miles an hour, to be a mile behind is nothing. A mere puff of wind in the sails of the lagging craft, and in a minute or two it is leading the race. A twenty-mile course may be run in less than forty minutes if a good wind is blowing. The helmsman, in calculating his moves, continually thinks a mile or two ahead.

SINCE the days of Peter Stuyvesant ice boats have been employed for various purposes on this continent. It is said that during the period of the French and Indian War, sleighs with sails were used to transport troops across the Great Lakes. And one of the early Dutch settlers along the Hudson is said to have used a sailboat mounted on runners to carry sheep across the ice. In 1861 the first regular ice yachting club was organized on the Hudson River, followed soon after by similar clubs on the Shrewsbury River, and today the inland waters of the United States from the Great Lakes to the Atlantic coast are dotted with clubs. A few are to be found among the great and small lakes of the Northwest.

The centers of activity vary. At one time Poughkeep- (Continued on page 142)

COMING—"The Truth about Hypnotism." Is there really such a thing? If so, what can a hypnotist do? How does he do it? An eminent psychologist answers from experience.

A sparkling day, a stiff breeze, close-hauled sails, and express-train speed. That's a sport of thrills for the ice yachtsman. As the skeleton craft skims the glassy river on one runner, it seems almost to be leaping through the air. It requires the utmost skill to keep the boat from skidding or upsetting.

Two smaller boats racing neck and neck. The one at the right, caught by a sudden gust, is bucking like a broncho, threatening to throw its pilot overboard. Occasionally an ice boat thus disposes of its crew during a race and darts off for an exciting runaway, knocking over spectators and smashing other boats.

Canyons from the Sky

Where a forced landing would mean sure death. Over the perilous Grand Canyon region in Arizona, daring airmen flew for two days to obtain these photographs. The view above shows the Rainbow Natural Bridge, at the left center.

The Lone Sentinel of Monument Valley in northern Arizona rises as high as the Woolworth tower. Like other similar peaks, it was once a part of a great rock mass, but was slowly carved away by the winds, rains, and frosts of centuries.

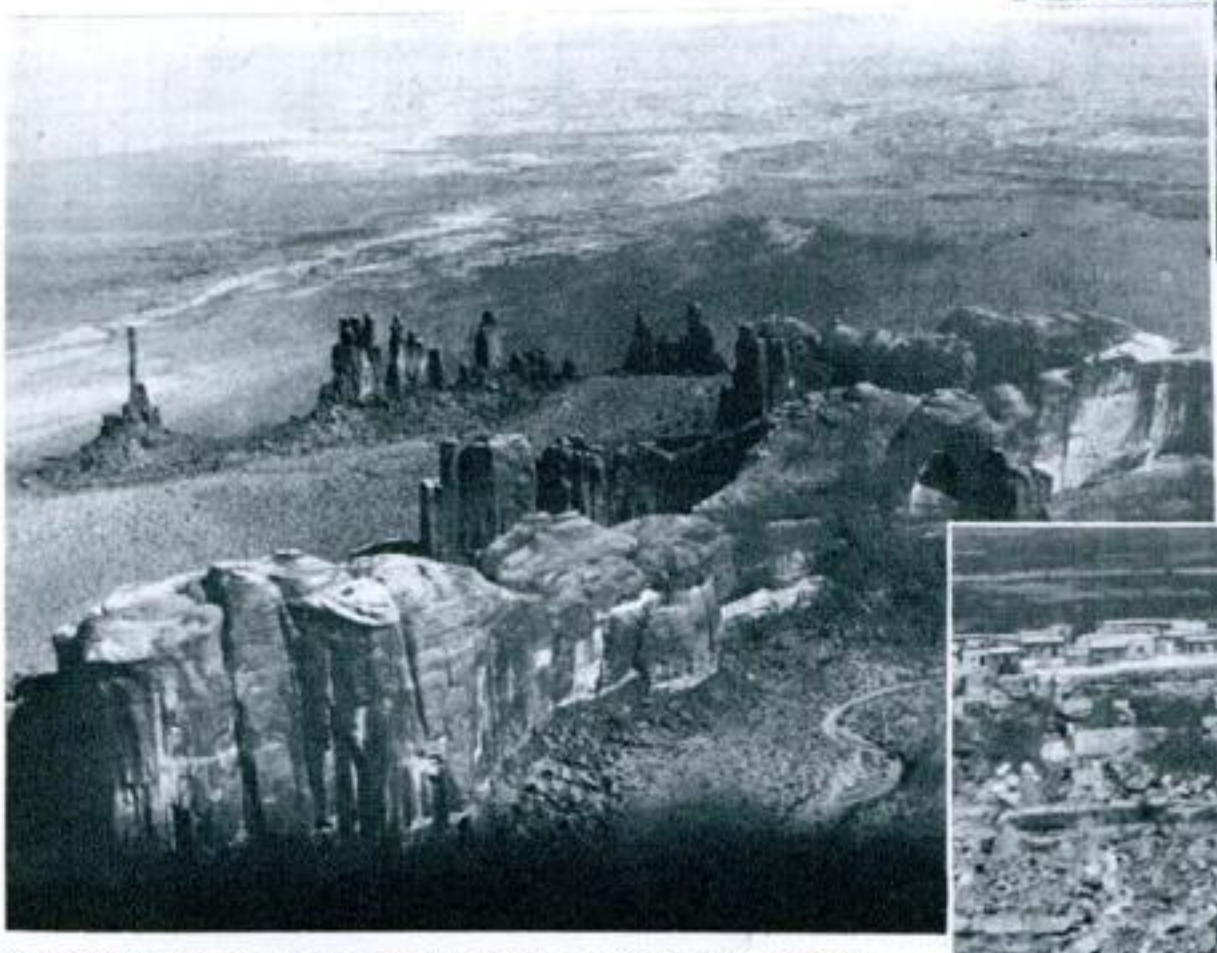
The two airmen who photographed the canyons, with one of the two planes they used, a Curtiss Robin. They are Frank King, cameraman (left), and Captain Hal George, U. S. A., the pilot.

Looking down upon the new Lee's Ferry bridge across Marble Gorge, just above the Grand Canyon. The first bridge to span the Colorado, it opens a new wonderland to tourists (P. S. M., Oct. '28, p. 19).

Flying 10,000 feet above sea level over one of the many canyons in Arizona. Tourist planes soon may fly on regular sight-seeing trips over these impassable wastes, enabling the public to view for the first time their scenic grandeur.

Above the Grand Canyon on the first day of the flight, at an altitude of 12,000 feet above sea level. The Colorado River, winding through the magnificent gorge, is seen in the right center of the photograph. The second day's flight, made in a Ford tri-motored plane, covered about 700 miles in a great circle around the Grand Canyon. On this trip the flyers were in the air for about seven hours.

Coal Canyon, Arizona, a desolate but gorgeous waste. From the air, the flyers say, it appears to have as many colors as a rainbow. Its name originated in the belief, at one time, that it contained deposits of coal. No place for a forced landing.



"A most gruesome sight to meet out in this wilderness," was the way Frank King, the aerial photographer, described Monument Valley in Arizona. Its strange rock formations, carved by time, make the valley "look very much like a cemetery." Some of the monuments rise as high as 600 feet.

The airplane calls on primitive cliff dwellers. The photograph at the right shows the Wallapi Indian village at Wallapi, Arizona. This isolated tribe dwells in cliff houses atop a large plateau.

WHEN DO WE EAT?

"Now!" replies the Bengal tiger, displaying a jaw-spread of alarming width and depth. In the jungles the big cat dines mostly on cattle, deer, wild hogs, and peafowl. When it grows old and too lazy to hunt, it may become a "man-eater," hanging around the native villages in wait for a free lunch.

The bat grabs its meals—mostly insects—on the fly. Largest of this curious tribe of winged mammals is the Malay "flying fox," which measures a foot long, with a wing spread of five feet. Some are blood suckers—hence the name "vampire bat."

Calling for a fish dinner. A close-up of the huge "sea elephant" is a rare sight, for these mammals, largest of the true seals, are almost extinct (P.S.M., Jan. '30, p. 65). The bull elephant seals grow to a length of twenty feet, and some weigh more than two tons. At one time they were plentiful along the California coast.

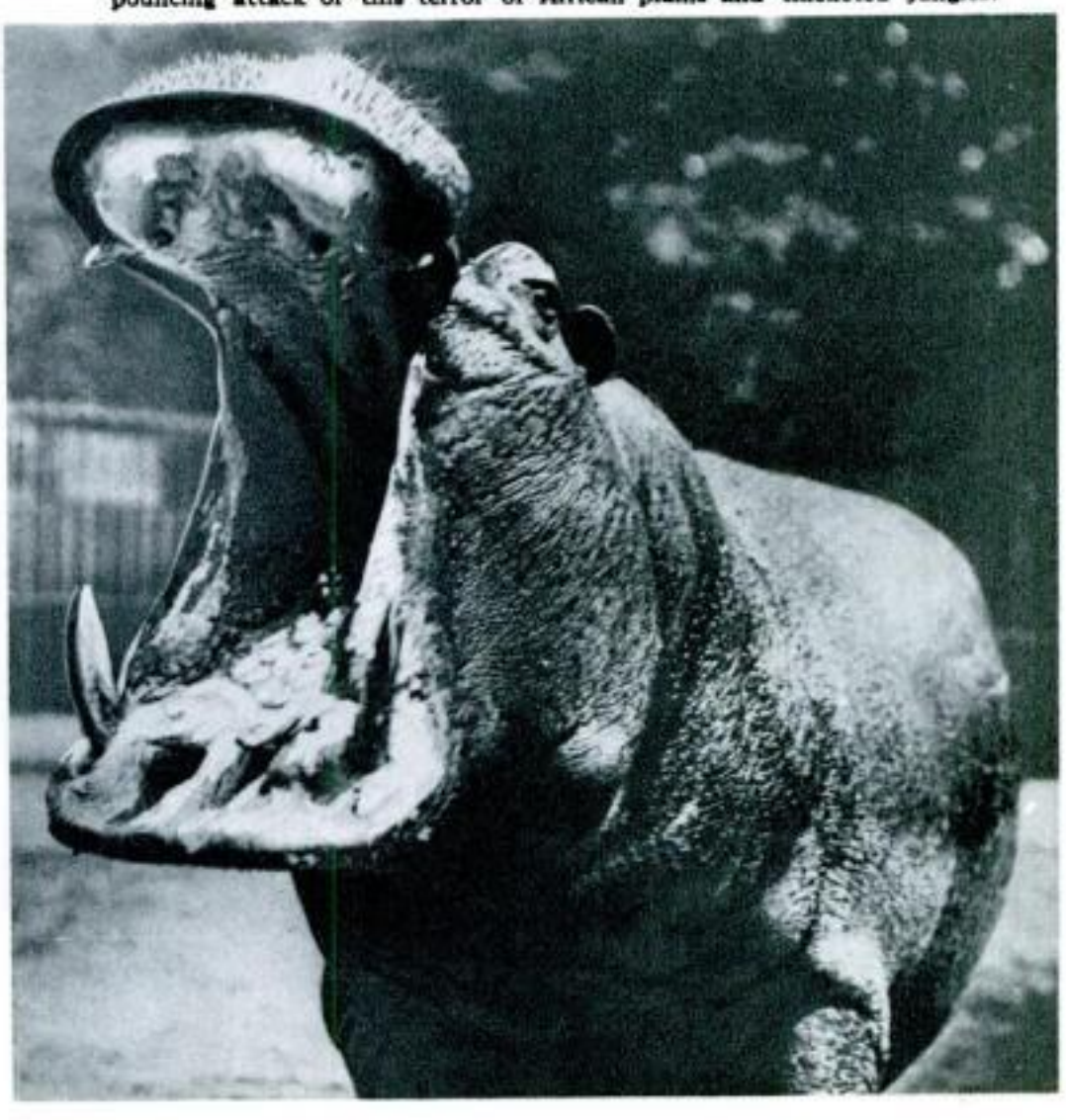
Caged in the zoo, the white polar bear longs for an old-time dinner of Arctic seals and fish. A mark which distinguishes it from other bears is a nonskid coating of hairs on the soles of its feet to aid in walking on the slippery ice. The white fur apparently is intended to conceal the animal from its prey.

Five baby flycatchers asking for their supper. House flies, grasshoppers, moths, and caterpillars are their particular meat. Their favorite haunts are in orchards and gardens.

"Fish!" That's the dish of the pelican, the great waterfowl that haunts the margins of lakes and rivers. It is distinguished by the large skin pouch which hangs like a basket underneath its bill.

When a hungry lion bares its teeth, no man or animal is safe. Buffaloes, giraffes, and even young elephants and rhinoceroses fall before the savage, pouncing attack of this terror of African plains and thicketed jungles.

The curious tree kangaroo of New Guinea grasps its food in exceedingly strong, hooklike claws. It feeds mostly on bark, leaves, and fruit. Its forearms are much longer than those of the true kangaroo. At the right: The cavernous hopper of the hippopotamus explains how the animal can put away five to six bushels of grass at a single meal. It swims in rivers of Africa.



They Got There Just the Same

When the Rajah rides in state at Delhi, India, he travels in a golden two-wheel limousine drawn by lumbering elephants with gold-tipped tusks. The windows of the car are hung with silk curtains.

Plenty of leg room in the de luxe sedan of Angola, West Africa. Two dusky natives, slinging a hammock across their shoulders, supply the motive power.

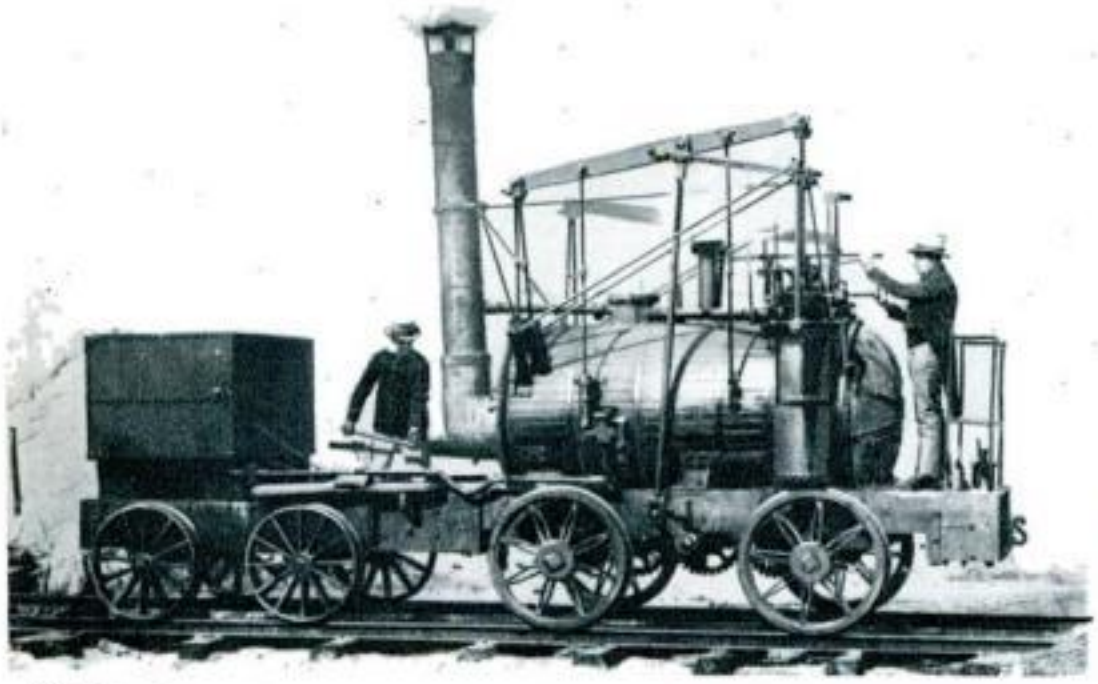
When bicycling and leg-o'-mutton sleeves were the rage, in the gay nineties. Sunday in the park was a whirl of glittering spokes.

For speed, the honking motor car may have all the advantage, but for real thrill the old tally-ho coach, with its liveried bugler, was hard to beat. It vanished from the highroad with the nineteenth century.

Careful there, girls! Hold the reins tight, for the nag is frisky and the buckboard has a short wheelbase. In the days of this picture driving was an art. Just notice how the young "chauffeuse" holds the whip.

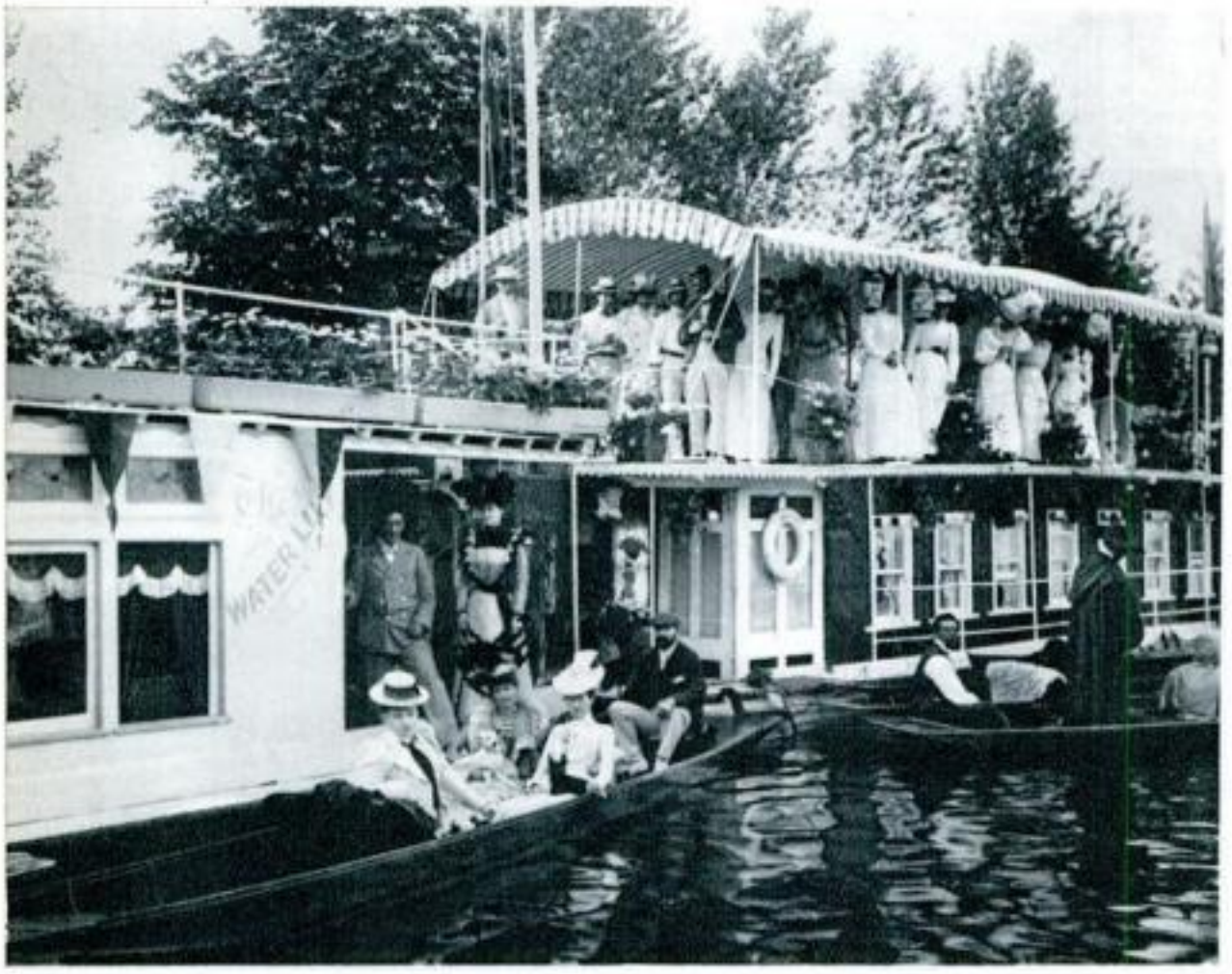
Early indications of a transition from the steam railway to automobiles are seen in this combined locomotive and carriage that appeared in 1862. It was designed to run on three wheels, without rails. Note the general resemblance to a hansom cab.

Looking Back Along the Road in Transportation; Quaint Predecessors of Modern Speed and Power



"Puffing Billy," Stephenson's first locomotive, which started the railway revolution in the early nineteenth century. Folks complained it would kill crops and cattle.

The sure-footed donkey still serves in the Orient, Mexico, and southwest United States.



A "wild" houseboat party on the Thames in the easy-going Victorian days. Though the boat scarcely moved, the gay sparks had a great time. The modern descendant of this craft is the speedy cruising yacht.

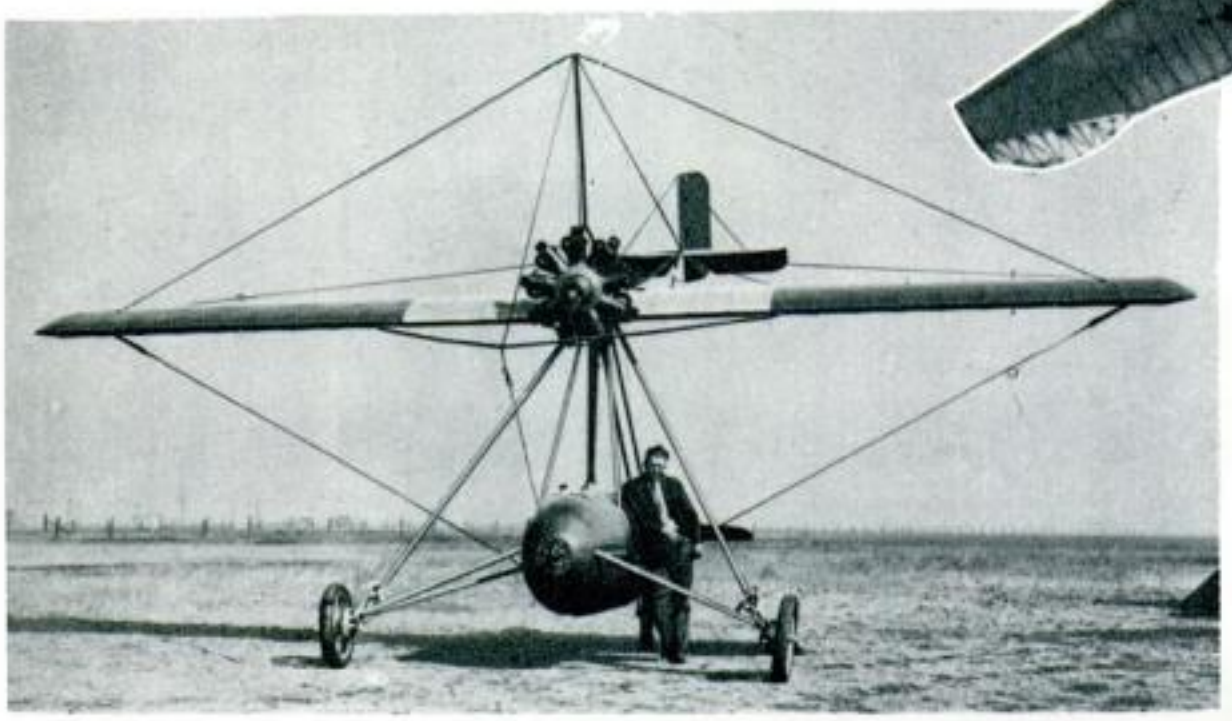
Piloting a horse car in Constantinople. The horn at the driver's neck is his warning "bell."

This old print shows how an Army train of the General Custer variety crossed the plains of the West less than a century ago. Slow ox teams hauled supplies in covered wagons.

In the early days of automobiles the Dion-Bouton victoria was the most fashionable car in Paris. The design of its radiator is still followed in some of the French machines.

Keeping Pace with Aviation—The Latest Inventions

The new tailless "Stork" monoplane designed by Gottlieb Espenlaub, famous glider pilot (P.S.M., Jan. '30, p. 134). It is powered by an eight-horsepower motor and pusher propeller, and can be sold for about $800.



This curious "pendulum" monoplane, the creation of Rolla V. Norris, Portersville, Calif., is designed to be proof against tail spin or nose dive. The fuselage, suspended six feet below the wings through a universal joint, is said to hang level at all times in the air.

New airport traffic signal at Los Angeles, Calif. When green lights shine skyward, red lights shine on the field, and vice versa, preventing collisions between outgoing and incoming ships.

For sport—a motorless seaplane glider developed at Lake Orion, Mich. For the take-off it is towed by a speed boat. At thirty miles an hour it is said to take the air. Wing span is thirty-six feet.

Fishlike fins are the latest attachments devised by Dr. C. M. Vance of Pomona, Calif., to increase a plane's stability. The two horizontal flippers under the nose are for fore-and-aft stability, while vertical fins fastened beneath the upper wing are said to aid in preventing side slips or tail spins.

Streamline "shoes" covering the landing wheels aid in making the new Travel Air "Mystery Ship" (left) one of the fastest of planes. These and a cowl surrounding the 300-horsepower motor cut down head resistance on the bulletlike craft. In the National Air Races at Cleveland, Ohio, last summer this plane outdistanced the fastest Army and Navy machines. Its top speed is 227 miles an hour.

Testing a Transatlantic Mail Rocket—The Latest Advances in Airplane and Dirigible Construction

NOW ready for test, the first model of the transatlantic mail rocket designed by Prof. Herman Oberth, Berlin experimenter, will fly alone. No human being will venture ascent in the thirty-foot projectile that the inventor plans to fire over the North Sea in a test of its propelling fuel.

The model consists of a slim iron pipe, lined with copper and filled with liquid oxygen. Four carbon rods to be placed in the oxygen chamber will burn so violently that the escaping gases are expected to drive the projectile at the terrific speed of sixty miles a minute. A parachute is attached to the model so that it may be recovered after its test flight.

Larger rockets of this type equipped with suitable steering apparatus may cross the Atlantic in thirty minutes, Prof. Oberth predicts. They would be used principally for carrying mail, and would carry a human pilot.

Two unusual photos of a parachute jump. Above: Harry Bushmeyer preparing to leap from a plane 2,000 feet above Roosevelt Field, N. Y. Deliberately entangling himself in the ropes of his 'chute, he dropped 1,000 feet before extricating himself. His purpose was to prove that a jumper, caught in such a predicament, is in no grave danger. At the right he is seen plunging downward through the air before the parachute opened.

Girders for Airships Made Lighter

A STRUCTURAL girder so light that a sixteen-foot length can be lifted by the little finger, yet so strong that it will support sixteen men, is one of the latest achievements of the United States Bureau of Standards. It is made of trussed aluminum strips, and is being used for airship building.

Research at the Bureau of Standards has covered almost every phase of aeronautical engineering. One recent achievement was the discovery of an artificial substitute for goldbeater's skin, the animal membrane used for making the gas bags of dirigibles. In another novel series of tests of the lightweight alloy duralumin, small strips of the metal are floated in the air on fine air jets that shake them hundreds of times a second until half a billion vibrations are completed. These simulate the "fatigue" in the internal structure of the metal caused by its actual vibration in flight.

"Weather Room" Reveals Best Aircraft Colors

SUNNY days like those of midsummer, or nights with full moon and starlit skies, are reproduced at will in a unique "weather room" constructed by a Pittsburgh, Pa., glass company to test the advantages of different colors for increasing the visibility of airplanes.

The unique chamber, a room fifty-five feet square and fifteen feet high, is equipped with artificial lights. Steam is shot in through pipes, smoke through flues, and water from ceiling sprays to reproduce artificially anything from a thunderstorm to a dense fog. Model planes, painted in different colors, are placed in the room and each one observed under fifteen different weather conditions thus made to order.

A pilot in flight can best see another airplane of solid color, the tests showed, when it is painted a dark blue. Chrome yellow ranks second in the experiments for greatest average visibility in the air, and orange, red, and green next. Light blues or grays make a plane hard to distinguish in the air. Aluminum paint has the poorest visibility of all because of its tendency to reflect all colors. A good two-color combination for visibility proved to be yellow and red.

Four-Hand Airplane Clock

TWO minute and two hour hands are features of a new style of clock developed especially for use in airplanes. Two stationary hands are colored red and are set by the pilot at the start of a flight by means of a knurled knob to show the time of the take-off. The other pair moves in the usual way.

Comparison of the two sets of hands shows the length of time the plane has been in the air, without the need of any intricate stop watch mechanism.

Commercial "Blimps" Fly 132,000 Miles Safely

SIX "blimps" operated by an Akron, Ohio, rubber concern and forming America's only commercial dirigible fleet are reported to have carried 6,000 passengers more than 132,000 miles without injury to passengers or crew. The tiny dirigibles have landed more than 4,000 times in establishing this record.

Some of the flights have taken the small airships considerable distances across country. The largest of them, the *Defender*, has a cruising radius of 1,000 miles. This ship carries six passengers in addition to its crew. Only two of the ships, the *Pilgrim* and the *Puritan*, have been in service as long as a year.

Following the success of the new metal blimp *ZMC-2*, built in Detroit, Mich., for the Navy, the builders announce plans for a new all-metal dirigible nearly as long as the *Los Angeles*. With a lift even greater than that of the *Los Angeles* on account of its thick shape, the new ship would carry fifty passengers.

Meanwhile work is progressing at Akron, Ohio, on the *ZRS-4*, the Navy's newest airship, which, like its sister ship to be constructed, will be as big as the *Los Angeles* and the *Graf Zeppelin* put together. The ceremony of "laying the master ring," by driving a gold rivet, was performed recently.

A Clearing House for Inventions

NO MATTER how queer the inventions of aviation enthusiasts, a number of manufacturers take pains to consider them carefully for fear that otherwise some really revolutionary idea may be lost. A Detroit aircraft firm even maintains a special research bureau to consider the worth of what are generally regarded as "nut" inventions.

One hopeful inventor, this department reveals, submitted elaborate drawings of a remarkable scheme in which the blast of an airplane propeller would operate another motor and help drive the plane—a sort of "perpetual motion" idea.

Another had a new way of keeping airplanes from getting lost in the fog. At the home airport there would be a large spool of thin wire, with one end attached to an outgoing plane. On the trip home the pilot would reel in the wire and follow it back—or so thought the inventor.

For a round-the-world flight, one in-

The helicopter idea applied to a large metal monoplane designed by Victor Allison and Jess Johnson of West Palm Beach, Fla. Under each wing is a nineteen-foot horizontal propeller intended to increase the lifting power. In a recent test at Milwaukee, Wis., the plane is reported to have taken to the air after a run of only seventy-five feet.

ventor conceived a huge plane that would drop passengers in gliders as it passed without stopping. In another plane a possible safety device for a disabled plane was a large rubber bag which inflated with hydrogen from a tank, would sustain it like a balloon. Just how such feats were to be accomplished the inventors in their enthusiasm sometimes overlooked. None the less, according to the aircraft concerns, any really promising scheme is sure to obtain careful consideration.

Only One Out of Twenty Passengers Is Airsick

ONLY about five percent of air passengers are subject to "airsickness," that curious aerial malady that corresponds to seasickness on the ocean. This is revealed by a survey recently made by the Daniel Guggenheim Fund for the Promotion of Aeronautics, which also concludes that airsickness is much more easily prevented and cured than seasickness.

The three causes which lead to airsickness, it was found, are, first, nervousness; second, bad ventilation; last and least important, the motion of the plane. Airsickness is almost entirely restricted to passengers flying in closed cabin planes.

New Pursuit Plane Goes 181 Miles an Hour

DRIVEN by a 600-horsepower motor, and with the framework of its streamlined fuselage constructed of a new lightweight type of steel, the P-6, latest Army pursuit plane, is said to be capable of a speed of 181 miles an hour. Officials say that it will enable the United States Army Air Corps to bid successfully against the air services of the world for supremacy in pursuit aircraft.

The chief feature of the new plane is its lightness. Besides the reduction of weight by the use of light alloy steel in the frame construction, the weight of the cooling plant and the head resistance have been lowered by the introduction of a special chemical liquid cooling system, developed by the Engineering Section of the Army Air Corps at Wright Field, Dayton, O. This innovation is said to have brought the weight of the liquid-cooled engine down to that of an air-cooled power plant without sacrificing any of the advantages of liquid cooling. In comparison with water, only a small quantity of the new liquid is required. Consequently the frontal area of the plane, owing to smaller radiator surfaces, is reduced by forty percent.

When empty, the plane weighs 2,430 pounds. It has a high speed of 181 miles an hour, a cruising speed of 145 miles, and a stalling speed of 61.3 miles. It carries fuel enough for a flight of 176 miles at full throttle, or 272 miles at cruising speed, and is equipped with an auxiliary tank with an additional fifty gallons of fuel.

Air Mail to Patagonia

PATAGONIA, the sparsely inhabited southern region of Argentina and long the symbol of remoteness, is now linked to the rest of the world by air mail. Twice-a-week mail and passenger service has just been inaugurated between the city of Commodor Rivadavia, situated less than 600 miles north of Cape Horn, and Buenos Aires, in Argentina. Through the new link and connecting American airways, a letter takes but ten days to travel between Patagonia and the United States.

Largest Amphibian Could Fly across Ocean

DESIGNED for transatlantic flying, a new amphibian built at Chicago is said to be able to fly 4,200 miles without alighting. It is the largest of its kind in the world.

The all-metal liner has a wing spread of seventy-two feet and carries fourteen persons. Its three motors give it a high speed of 130 miles an hour. Eleven more of the giants are to be built during 1930, and a 125-passenger plane, to be of similar design, is projected for the future, it is reported.

Latest of U. S. Army pursuit planes, the Curtiss P-6, has a top speed of 181 miles an hour. A special chemical cooling system has permitted reduction of the weight of the motor, and also has lessened the radiator surfaces, thus reducing head resistance. Without load the plane weighs only 2,430 pounds.

Air Express Has Carried Nearly 3,000 Tons

ABOUT 5,845,000 pounds of express have been carried by airplanes operating over American air lines during the last three years, according to a recent report of the United States Department of Commerce. Fast delivery of newspapers is one of the services performed by express planes, and another has been the transfer of large sums of money in bullion and currency. Cut flowers, jewelry, vegetables, and fruits are among the other varied items that have been speeded by air express.

Stickers Call Attention to Air Mail Letters

BUSINESS letters by air mail would receive special attention, plane operators have contended, if the recipient of such a letter knew that it came by air. However, the envelope, the only evidence of its manner of delivery, often is removed and thrown into the wastebasket before a letter reaches the person to whom it is addressed.

Recently an eastern air mail line tried the experiment of printing a gummed sticker bearing the words "Air Mail" that could be attached to the letterhead of every letter dispatched by plane, and distributing the stickers to 3,000 business houses. The plan worked so successfully that more than a million of the stickers have been used so far, and 40,000 firms have requested supplies.

Guggenheim Safety Test Has Few Survivors

FOUR planes still remained in the Daniel Guggenheim Safe Aircraft Competition at this writing, with a fifth a possible contestant. The rest of twenty-five planes originally entered either had failed to pass the qualification tests or had withdrawn. Two of the planes had crashed.

The object of the competition, at Mitchel Field, N. Y., is to develop a "foolproof" type of airplane for general use. The machine that best performs the difficult maneuvers required by the rules is eligible for a grand prize of $100,000, and five consolation prizes of $5,000 each are to be awarded.

"Wing slots," small auxiliary wings to

eliminate risk of tail spins, distinguish the Curtiss Tanager which was leading the contestants with fifteen of the eighteen required maneuvers successfully accomplished. They resemble those of the Handley-Page, the only surviving British entrant, except that they are manually controlled. Those of the Handley-Page, which was second with twelve maneuvers accomplished, were automatic.

One of the remaining contenders was the Cunningham-Hall plane, most radical of all, a monoplane with a tiny stub wing above it. Air streams through the hollow lower wing. A Ford-Leigh plane, with a different type of slot or "safety wing" from the Curtiss and Handley-Page, also remained.

Passengers Ride in Wings of Biggest Land Plane

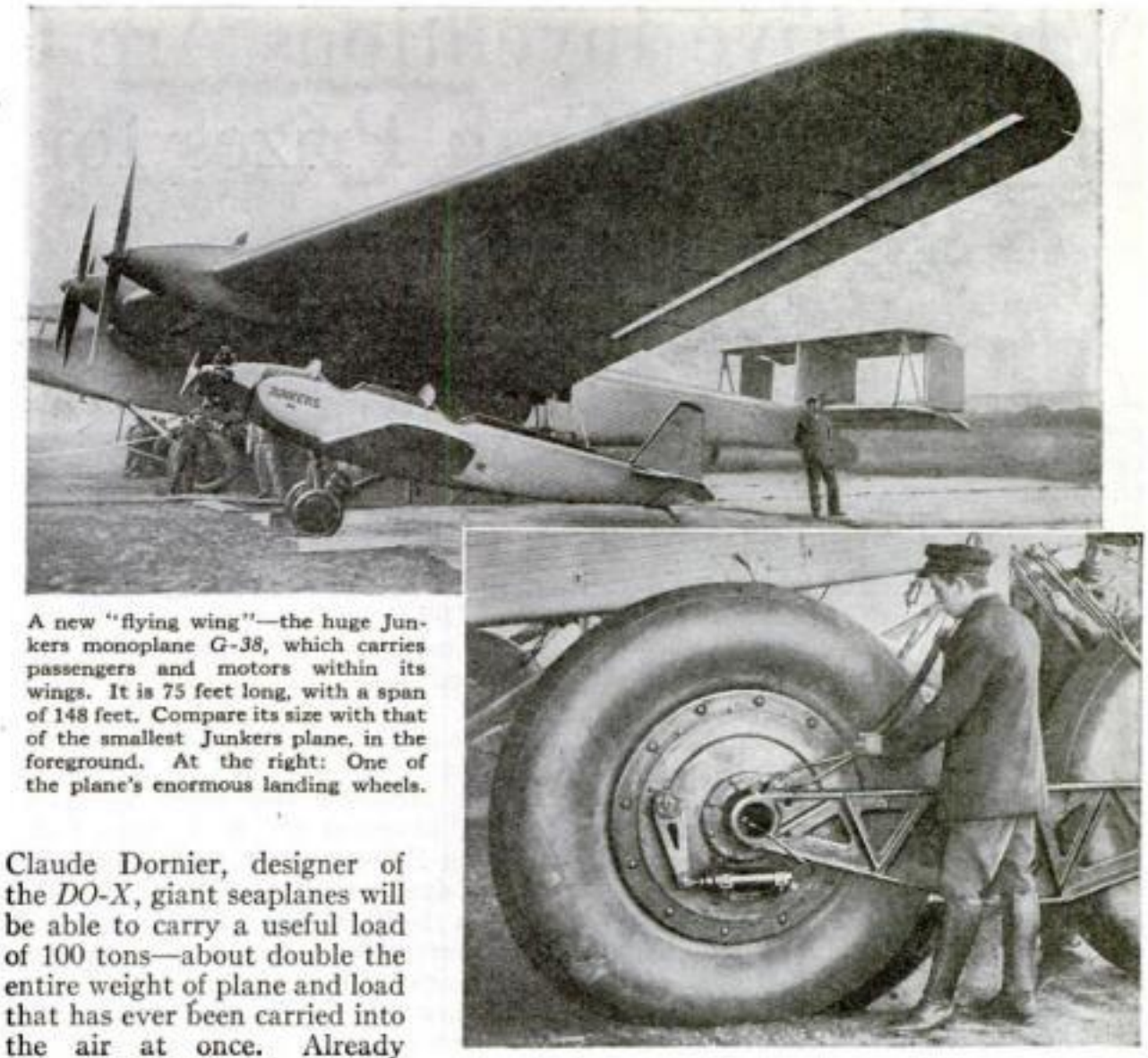
IN A successful maiden flight of half an hour, the world's largest land plane—the Junkers monoplane *G-38*, with a wing span of 148 feet—recently vindicated the expectations of its builders. It is called the nearest approach to the ideal of airplane designers—a "flying wing," unimpeded by outer projections and with exposed motor surface and fuselage reduced to a minimum.

Passengers ride actually in the wings of the giant craft, and view the passing scenery from glass windows cut in the wing surface. Motors also are placed within the wings, which are thick enough for a man to walk erect inside them. Four huge wheels about the size of locomotive wheels constitute the landing gear and absorb the crushing blow of the ship when it lands.

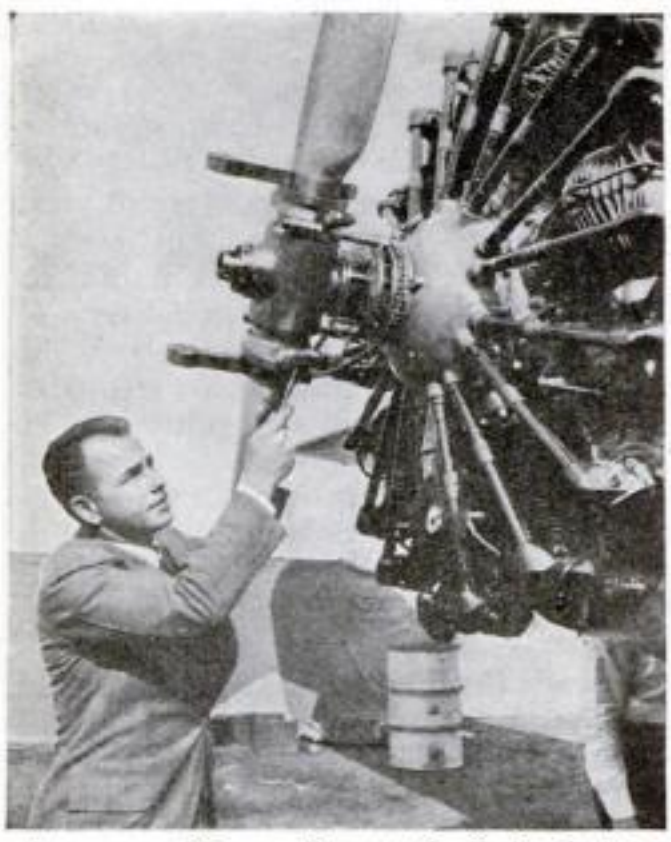
The ship is designed to accommodate forty passengers, although it can carry a hundred if necessary, placing it not far behind the Dornier *DO-X*, the largest seaplane in the world, with its wing span of 160 feet. The Junkers land plane is seventy-five feet long, compared with the 130-foot length of the Dornier monster. The Junkers' four engines total 2,400 horsepower—the Dornier's twelve motors total 6,300 horsepower.

Within ten years, according to Dr. Claude Dornier, designer of the *DO-X*, giant seaplanes will be able to carry a useful load of 100 tons—about double the entire weight of plane and load that has ever been carried into the air at once. Already Dornier planes of the size of the *DO-X* are planned to be built in the United States. The British Air Ministry has contracted for a twelve-motored plane of similar dimensions, but with three wings, one above the other, and a greater flying speed.

Even greater ships are projected. On another page is illustrated the plan of Dr. W. W. Christmas, Connecticut airplane designer, for a 160-passenger air liner for cross-country service in the United States. Another eastern firm is planning an air liner capable of carrying 500 passengers and a crew of 104 between New York and London. This company proposes to build first two experimental craft, costing $5,000,000 each—two, because at least one is expected to be wrecked in the tests.



A new "flying wing"—the huge Junkers monoplane *G-38*, which carries passengers and motors within its wings. It is 75 feet long, with a span of 148 feet. Compare its size with that of the smallest Junkers plane, in the foreground. At the right: One of the plane's enormous landing wheels.



A new reversible propeller recently displayed at an aviation show in Los Angeles, Calif. When reversed it acts as a brake to aid in making a short landing.

Flight to South Pole a Navigation Triumph

ONE of the most serious problems with which Commander Richard E. Byrd had to contend on his recent spectacular dash by air to the South Pole was how to find his way back, air experts declare. Capt. L. A. Yancey, air navigation authority, points out that at the pole all directions are north. A compass is valueless. A flick of the wrist, and Commander Byrd might have found himself headed for far-off Asia or Africa instead of returning along the meridian of 165 degrees west longitude that brought him safely back to his base in Little America.

The flight was a unique test of airplane operation. By nineteen hours of flight through extreme cold and high altitude on the way to the Pole, Byrd gave his engines a try-out almost impossible to duplicate on the test block. Such information is particularly important in pushing air lines into frigid regions.

A special type of supercharger used on the central engine proved satisfactory in enabling the motor to "breathe" in the thin air under terrific load. The use of air-cooled engines was vindicated despite the fact that there was no way to shield them from the cold.

Cut Flowers by Plane

THROUGH a recently developed system of transporting cut flowers by airplane, thousands of tons of blooms from the Netherlands, put aboard fast planes at the Dutch airports of Schiphol and Waalhaven, reach foreign markets each day still fresh and dewy. Through this speedy means of transport, not only does the trip require only a few hours, but the aerial bouquets are safeguarded from rough handling.

Now—Flying "Minute Men"

TWENTY-TWO New Jersey civilians recently formed the "Newark Air Service," an independent flying organization, and started taking flying lessons. Then they donned uniforms of their own creation, appointed officers, and offered their services to the Government as a unit of flying "Minute Men" in the event of a national emergency.

Helium Cost Cut Again

NEW economy in producing helium gas for dirigibles is reported by the United States Bureau of Mines. The cost has now been reduced at its Amarillo, Texas, plant to less than a cent and a half per cubic foot. Once helium cost $2,000 a cubic foot.

Which Five Inventions Are Greatest? Seven Cash Prizes for Best Selections

A SPIRITED discussion was started among the editors of POPULAR SCIENCE MONTHLY the other day by the news that a Philadelphia judge had admitted the talkie confession of a burglar in evidence at the trial of the prisoner.

"Here," said Edgar C. Wheeler, Associate Editor, "is a striking example of the quick and far-reaching effects of an ingenious invention. The talkie is only a few years old. It has given pleasure to millions of people. It is being applied in education. And now, it plays an important part in a court room."

This led to a general discussion on the question of which inventions had exercised the greatest influence on the progress of civilization, and the talkie was soon forgotten. The electric light's golden jubilee was a recent memory. Edison's incandescent lamp readily found a champion in Raymond J. Brown, Managing Editor.

"From a nation of kerosene lamp trimmers and candle-users we were able to turn night into day with Edison's electric light," he declared. "I cannot imagine a greater contribution than the efficient illumination of electricity."

"And the electric lamp does things that kerosene lamps could never do," added Alden P. Armagnac. "Diminished to pea-size, it tips the end of a surgeon's instrument to light a delicate operation within the human body. In thousands of cities it controls traffic."

"Speaking of traffic," put in Israel Doskow, Art Editor, "how about the automobile? I nominate it as one of the greatest modern inventions. It is allowing people to broaden their minds by travel in a way that was impossible a generation ago."

"But the vehicle of the future is the airplane," said Edwin W. Teale. "With its speed it is opening a new realm of possibilities for linking the peoples of the world together."

"How about the steam engine?" Travis Hoke, the Editor, put in. "Watt's first steam engine was a crude thing, but it started an industrial revolution that brought about our modern system of factories and mass production."

"Today, however, electric power is running factories and mills as never before," observed Dr. E. E. Free, Contributing Editor. "We have Faraday's electric dynamo to thank for that. The dynamo had to come before electric lights were possible, or industrial power could reach its present stage."

"To my mind world communication is as important as industrial achievements," said Michel Mok. "My vote would be cast for Morse's telegraph and all the things that depend upon it—cables, stock market tickers, train dispatching systems."

"WHILE we are on the subject of communication," Alfred P. Lane, Technical Editor, added, "don't forget Marconi's radio and the way it has opened up communication lanes to hitherto inaccessible parts of the world. Why, even at the South Pole Commander Byrd could talk with New York."

"Don't forget to mention the telephone, too," added Arthur Wakeling, Home Workshop Editor. "And quite as important as single messages, I should say, is the distribution of knowledge by the printed word. When you're talking about great inventions you must not omit Mergenthaler's linotype machine."

In this manner, a score of inventions passed in rapid review. Aside from those mentioned, the following were deemed worthy of inclusion in a list of great inventions:

WHITNEY'S cotton gin, Westinghouse's air brake, Otto's gasoline engine, Tesla's alternating current motor, Hargreave's spinning jenny, McCormick's harvester machine, Goodyear's vulcanized rubber, Thomson's electric welding, Howe's sewing machine, Eastman's transparent photographic film, Sholes's typewriter, and Burroughs' adding machine.

If you had been present at this informal conference, would these selections have met with your approval?

Which five inventions and inventors do you consider greatest? For the best answers to this question, stating the reasons for your preference clearly and simply, in 300 words or less, POPULAR SCIENCE MONTHLY will award a First Prize of $50, a Second Prize of $25, and Five Prizes of $5 each. You may select your five favorite inventions and inventors from the foregoing list, but this is not obligatory.

In making the awards, skill and neatness of presentation will be considered as well as the actual contents of the answers themselves.

The Rules of the Contest

1 Which, in your opinion, are the five inventions that have exercised the greatest and most far-reaching influence on the progress of civilization?

For the best answers to this question, giving the names of the inventors and the reasons for your selection, POPULAR SCIENCE MONTHLY will award $100 in cash prizes—a First Prize of $50, a Second Prize of $25, and Five Prizes of $5 each.

2 Prizes will be awarded to those contestants setting forth their preferences in the clearest, briefest, neatest, and most skillful manner. Answers must not exceed 300 words in length. In making your selection of inventions, you may use those mentioned in the list printed elsewhere on this page, or you may substitute one or more choices of your own. The inventions chosen may be either American or foreign.

3 Entries must be sent by first-class mail, prepaid, to the offices of POPULAR SCIENCE MONTHLY not later than February 15, 1930. Answers may be submitted on any kind of paper, but they must be typewritten or written in ink, and on one side of the paper only.

4 All entries should be addressed to the Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. The name and address of the contestant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or nondelivery of entries. No contribution entered in this contest will be acknowledged and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

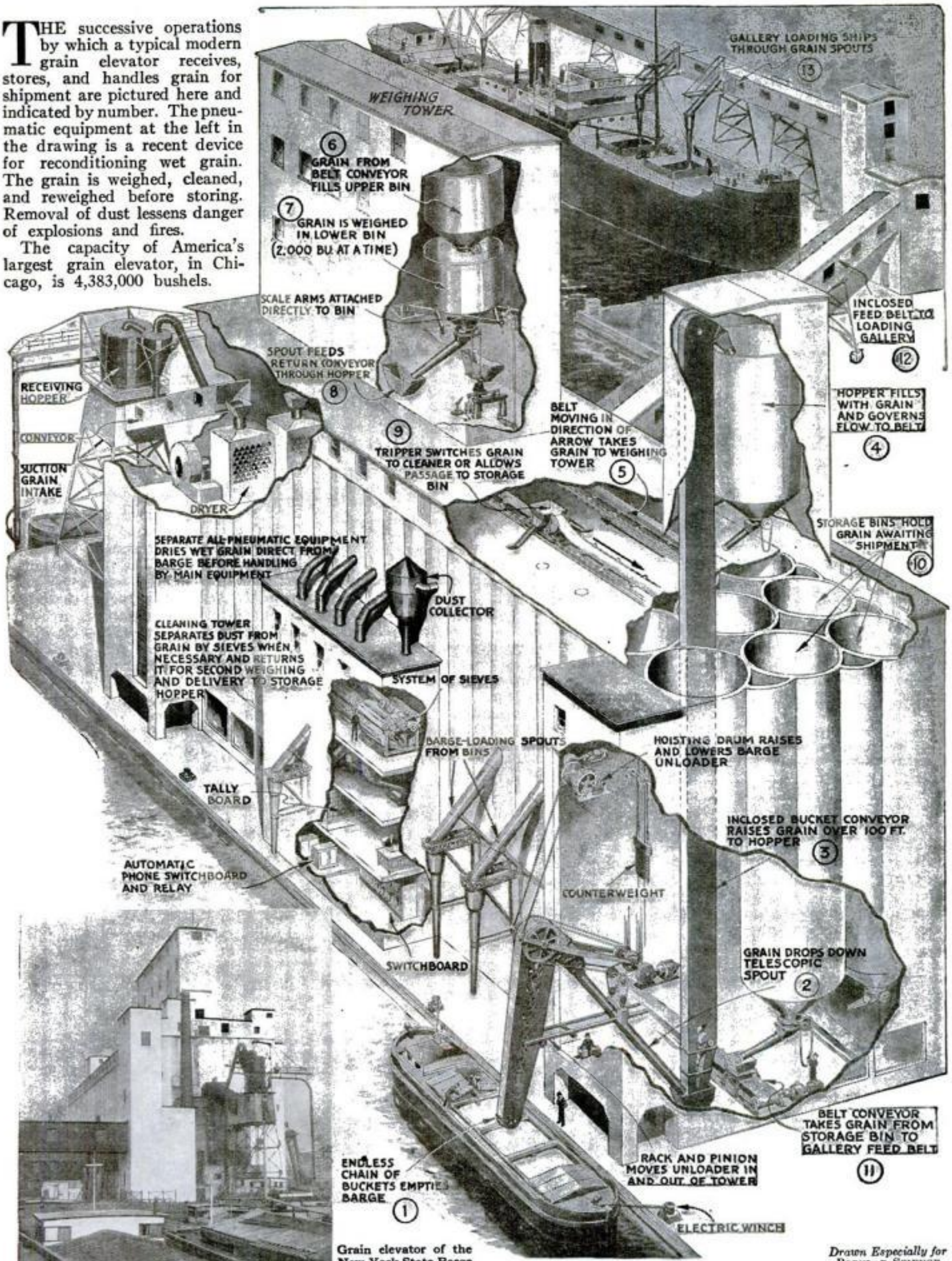
5 It is not necessary to buy POPULAR SCIENCE MONTHLY to compete. You may borrow a copy from a friend or examine one at the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. The contest is open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute and their families.

The Editors of POPULAR SCIENCE MONTHLY will act as judges and their decisions will be final. In case of a tie, the full prize will be awarded to all tying contestants. Acceptance of these rules is an implied condition of each entry.

Inside a Modern Grain Elevator

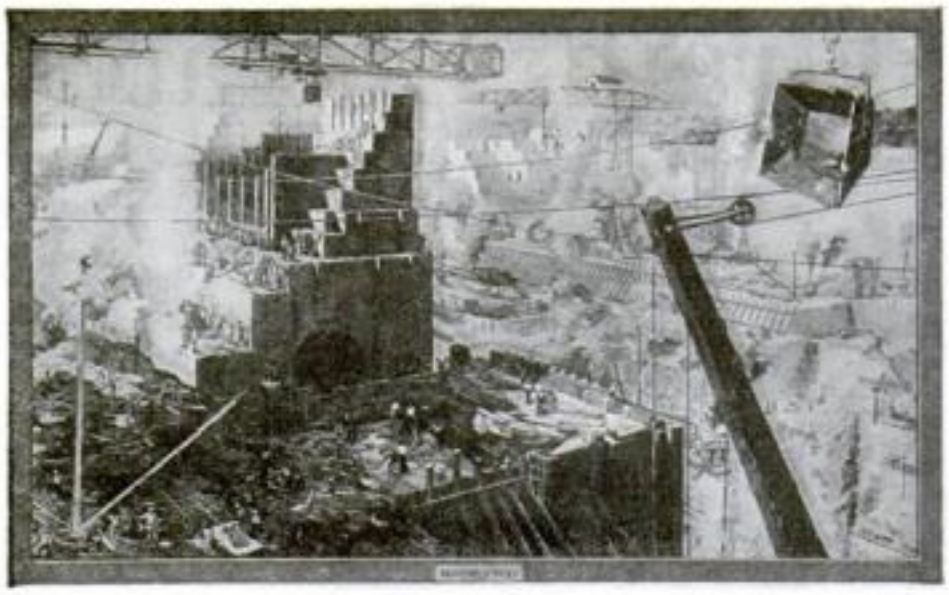
THE successive operations by which a typical modern grain elevator receives, stores, and handles grain for shipment are pictured here and indicated by number. The pneumatic equipment at the left in the drawing is a recent device for reconditioning wet grain. The grain is weighed, cleaned, and reweighed before storing. Removal of dust lessens danger of explosions and fires.

The capacity of America's largest grain elevator, in Chicago, is 4,383,000 bushels.

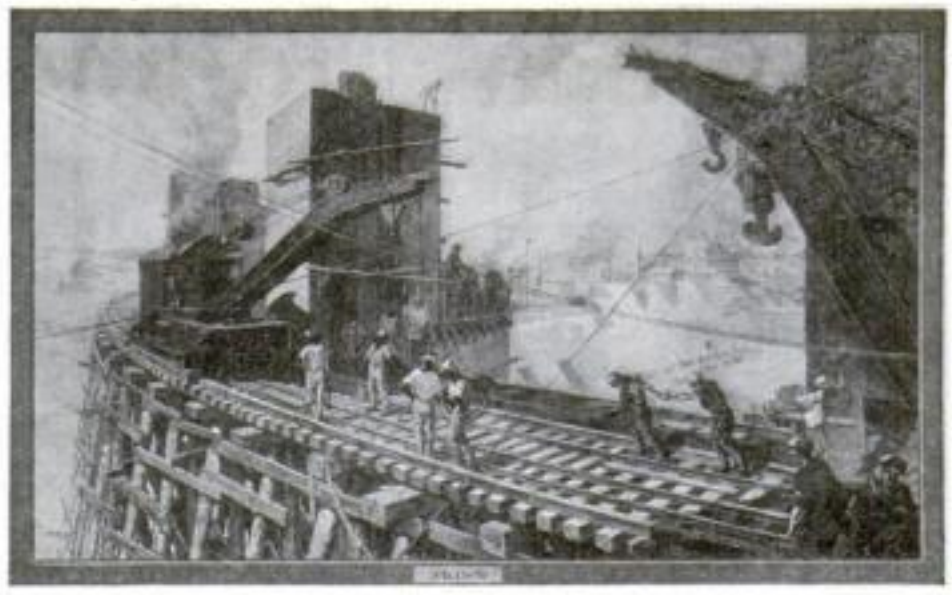


Grain elevator of the New York State Barge Canal terminal, Erie Basin, N. Y. Harbor.

Drawn Especially for POPULAR SCIENCE MONTHLY *by B. G. Seielstad*



One of the rescued paintings. It depicts construction of the Miraflores Locks which now lift vessels 55 feet from tide level to Miraflores Lake.



Constructing a gigantic spillway. These paintings are highly valued as the only official records on canvas of the building of the Panama Canal.

Canal Paintings Saved from Ruin

How Science Conquered the Mold Which Menaced Valuable Murals of the Great Panama Waterway

By

GEORGE LEE DOWD, JR.

A FEW months ago the five mural paintings depicting the construction of the Panama Canal, canvases covering 400 square feet of wall space in the Administration Building at Balboa, were in danger of extinction from the ravages of mold. Clusters of green and white fungi resembling damp talcum powder had apparently eaten through to the very paint of the murals, four of which are reproduced here. The question was how to get at the disease.

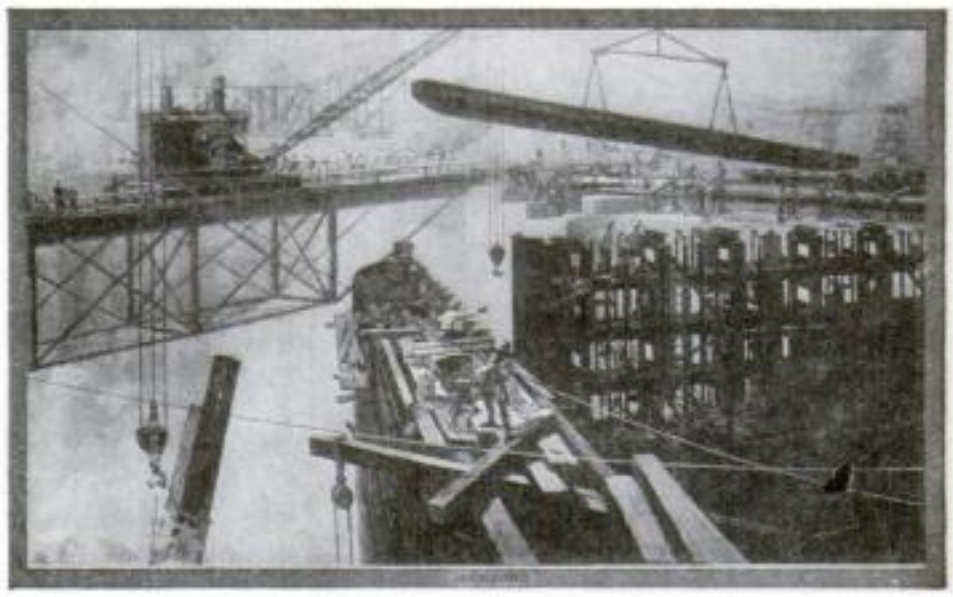
It was impossible to remove the pictures, fastened as they were to cement walls with 800 pounds of white lead. And the circular walls of the rotunda in which the paintings reside made a fumigation chamber out of the question. Mold experts, summoned from various corners of the world by the artist at the request of Colonel Harry Burgess, Governor of the Canal Zone, were baffled. But at last Prof. Albert B. Newman, Director of the Department of Chemical Engineering of Cooper Union, in New York City, devised a method of dealing with the trouble which produced remarkable results. He was aided by Dr. Charles Thom, chief mycologist of the Bureau of Chemistry and Soils in the Department of Agriculture; Dr. Alexander Scott of the British Museum, and other specialists.

There were four steps in the procedure eventually hit upon. First, the porous beeswax originally intended as a protective coating for the paintings was removed by alternate washings of turpentine and alcohol. The exposed canvas was then cleaned with a liquid fungicide, made up of thymol dissolved in alcohol, thus dispensing with a vaporized disinfectant. This killed the live fungi. The dead fungi were dispatched by a thorough washing with ammonia. The paintings were thus ready for a protective coating, which would guard them against any future onslaughts of vegetable growths which flourish in warm, moist climates. The coating applied was one of thin paraffin, which is transparent and without pores, dissolved in a liquid which later evaporates. Thymol was mixed with the paraffin as an added precaution against molds.

The results of the treatment were completely satisfactory. The paint emerged clear and fresh, and no retouching was necessary. W. R. van Ingen, the artist commissioned by Colonel George R. Goethals, the builder of the canal, to paint the series showing different aspects of the great engineering feat, was particularly pleased with the outcome of the restoration work, and declared that the paintings appeared as though they had been executed the day before. The pictures show features of the canal construction which are now hidden by fifty feet of water. To paint them with detailed accuracy the artist journeyed more than fifty times over the entire canal, making sketches.

THE successful use of thymol to save the paintings has suggested its extension to the elimination of mold in the tropics, where it is a constant menace and will attack anything that will nourish the seeds of the fungi.

Excavating the great Culebra Cut, a five-mile gash through a range of low hills. Recurring slides made the task one of tremendous difficulties.



Erecting lock gates. All of the gates are of steel seven feet thick. They range in height from 47 to 82 feet, and they weigh from 450 to 700 tons.

Meeting Emergencies in the Air

The War Bird-Instructor Who Taught Larry Brent Tells of Tight Adventures with the Unexpected

By ASSEN JORDANOFF

THE unexpected rides with every pilot. From the take-off run to the three-point landing anything may happen.

My strangest flying adventure took place only thirty feet above the ground. I had landed a Travel Air at a practice plot five miles from Curtiss Field, New York. At the far end was a high tension line. When I took off, the ship acted queerly. It would speed up and then slow down. It flew tail-heavy. It didn't climb right. At full gun it kept jerking along in rabbitlike hops through the air. Two seconds before reaching the high tension wires, I cut the gun and landed. What I saw when I jumped from the cockpit made my hair stand on end.

Assen Jordanoff. "It is conquering the unforeseen," he says, "that measures the ability of an airman."

A hundred and fifty feet of heavy steel cable dragged behind the plane. Years before, workmen, erecting the line, had left it lying in the weeds. The tail skid had picked it up and the bent ends of the cable had been jerking through the long grass like anchors.

In 10,000 flights such an accident probably would never be repeated. Another 100 feet in the air and the cable would have dragged over the high tension wires. The ship would have nosed down, crashing beyond them. Thousands of volts would have leaped along the cable to the ground. The pilot's seat would have become an electric chair.

The point of that story is the first rule in meeting emergencies in flying. The instant anything seems wrong with a ship, point down the nose. Land as soon as possible.

MANY times, little twists of fate play a big part in piloting. Not long ago, an experienced air mail flyer nearly crashed into a mountain in broad daylight. When his ship hit a bump in the air, dirt from the floor of the cockpit flew up into his eyes, temporarily blinding him. In the *St. Louis Robin*, Jackson and O'Brine flew continuously for seventeen days to set a new refueling endurance record. Later, Jackson started off on a fifteen-minute exhibition hop. He washed out a wing before he got off the ground. The heel of his new shoe had jammed under the rudder pedal.

But the strangest freak accident I know of happened to the pilot who sneezed off his landing gear.

It was in the World War. I was flying with the Bulgarian war birds on the Saloniki front. One of the pilots came back from over the lines in a fast, wing-clipped pursuit ship. As he leveled off with his motor dead, he felt a hard sneeze coming on. He took a quick breath. He wiggled his nose like a rabbit. No good. Just as the wheels touched, his eyes blinked shut, his head jerked back, and he exploded in a mighty "kerchoo!" It made him kick over the rudder, ground-loop the ship, and wipe off the landing gear. He was the most surprised pilot in all Europe when he crawled from the wreckage.

In a ground loop, a plane runs around in a small circle on the ground. At high speeds, the machine usually tips. A wing digs into the ground and a crack-up results. One instance where a ship is purposely ground-looped is when it has lost a landing wheel in the air. In this emergency, the pilot circles, if possible, over a field where he can get immediate attention in the event of a bad crash. He flies low several times to draw attention to the crippled landing gear. Then he brings the ship down into the wind at almost stalling speed, lowering the wing on the side of the good wheel. Landing on the one wheel, with the dragging wing almost touching the ground, the ship is ground-looped, reducing speed so that when the wheelless axle digs into the earth the plane is moving so slowly that it will not somersault.

"A 'chute can be guided by pulling ropes on side toward which you want it to swing."

An even more ticklish bit of piloting is bringing down a seaplane or flying boat on land. A forced landing beyond gliding distance of water usually means a smash. Sometimes a ship can be saved by setting it down in the greenest field in sight. The plant juices act as lubricant, allowing the hull or floats to slide along over the ground. The next best bet is a strip of sand. The grains roll. Avoid plowed ground. The fine dirt packs and offers high resistance. It is almost as bad as a stretch of rock. When a land plane is forced down in water, the pilot skims low above the surface, stalls the ship, and pancakes down.

IN THE split-second emergencies of the cockpit there is no time to work out an elaborate plan of action. A flyer should imagine every possible accident which may befall him in the air. He should decide beforehand how to meet each. When the crisis arrives, he must act as instinctively as he winks an eye when a hand passes before it.

NEXT month: "Beating the Weather." What Jordanoff has learned from encounters with fog and storm, gales and sleet, in 16 years of flying. How a veteran faces problems every aviator must solve.

The other day, I was ferrying a new cabin plane from Boston. Three thousand feet above hilly country, white smoke began shooting from the exhaust. The motor was getting too much oil. A cylinder went dead. The plugs were fouling. There was only one good field in sight. I cut the limping motor and headed for it. If I had been flying low, I couldn't have made it. In a forced landing, altitude is as important to an airplane as lifting gas is to a balloon.

IF A motor cuts out at 500 feet, the pilot has less than three seconds to decide upon a landing place. And he can't change his mind. Unless he is above 200 feet, he must land practically straight ahead. Above that height, he can spiral. With a dead engine, the average ship can glide six or eight feet ahead for every foot it descends. That is, if it is a mile up it can glide six or eight miles before reaching ground. Over open country, I fly at an altitude of 2,000 feet: over rough territory, higher.

In a forced landing, the great problem is: How far can I glide? A simple way to estimate the distance is to put the ship down at its correct gliding angle. This can be determined by listening to the pitch of the humming wires. If the glide is too steep, the pitch is high. If it is too flat, the pitch is low. With a little practice, the ear learns to distinguish the correct sound. With the plane at this angle, sight along the nose. The spot where the eye strikes the ground marks the limit of your gliding range. Ordinarily any field below the nose of the ship can be reached. Those beyond the nose might as well be in Timbuctoo. If you try to reach them you will stretch your glide, lose flying speed, stall, and plunge to earth. "The graveyard glide" is the merited nickname for one that is dangerously flat. The opposite extreme, one too steep, is known around "The Student's Roost" at Curtiss Field as "The Otis Glide," because the ship drops like an elevator.

Jordanoff as a Bulgarian war pilot on the Saloniki front. In this article he tells how he got out of many tight places.

THE worst forced landing I ever had occurred during the war when my gasoline tank exploded over the enemy lines. We were fighting against the French near Saloniki. Two of our planes were shot down a few miles over the lines. We received word that several French machines had landed near by. Orders were given to bomb them. Four of our bombers took off. Bad weather and engine failure forced them back. A lone bomber was ordered to break through accompanied by two fighting ships. I was to pilot one.

We took off. I flew a Roland D3 at the left of the bomber, 200 feet above it. The other fighting ship, an Albatross, flew 200 feet above me, at the right. We neared the spot where the bombs were to be dropped. Then I noticed the needle of the air pressure gage on the gasoline tank moving steadily ahead. A pump on the plane forced air into the tank—upon which I sat—to drive fuel to the carburetor. If the pressure kept increasing, the tank would explode under me. I tried to shut off the pump. It stuck. I reached for the valve on the tank to let out some of the air. It broke off in my hands. Just then, I saw the big machine below dive, twist, and race for the lines with motors wide open. The observer was frantically flashing a red signal. This indicated that the enemy had come forward to attack us.

I forgot the gasoline tank—about to explode any minute. With a spiteful whine, three Gnome-Nieuports plunged from the clouds. Two dropped upon the Albatross, highest in the air. One headed for me, his machine gun blazing through his propeller. The bullets ripped across my wing, leaving a trail of holes like the perforations between postage stamps. He plunged on, diving over the bomber. I dove over him. We went around and around, looping and twisting, our machine guns rattling above the whine and roar of the motors. The Albatross disappeared, shot down in the first onslaught. The other two Nieuports fell on the huge bomber like kingbirds attacking a hawk. At one time, the big plane was forced to 300 feet, and I was only slightly higher. The artillerymen had gone crazy. They shot at all the planes in the sky indiscriminately. If a rabbit had appeared, they would have shot at it too.

NEAR the lines, the Nieuports turned back. I remembered the gas tank, pulled back the stick, and climbed for all the plane was worth. And it was none too soon. At 6,000 feet, there was a jar, a rush like wind in a tunnel. A deluge of gasoline struck the back of my legs. The cockpit was flooded. I cut the switch. I could hardly breathe for the fumes. Fortunately the tank had burst on the side instead of at the top. By a miracle, the motor did not catch fire. On our side of the lines was a mountain with a tiny farm at its top. I headed for it with a dead stick, set the plane down in the farmer's back yard, crashed through a fence into the barn lot, missing cows and chickens, and stopped only a few feet from a row of trees. I had hardly climbed out when a distant droning increased. Two light bombers circled overhead trying to destroy the ship. When they headed back for more bombs, the farmer and his wife helped me drag brush to cover the plane. This camouflage saved it.

WHEN a pilot comes down in a forced landing that looks as though it may end in a crash, he should do four things. He should strip off his goggles before he hits. It saves his eyes from the danger of splintered glass. He should be sure his safety belt is fastened. It keeps him from being thrown out in a sudden stop or if the ship noses over. He should cut the switch. It lessens the danger of fire. He should keep his eyes open until the last minute. Some pilots plan to throw their arms across their faces before the plane strikes. I watch everything to the last second. Often I can see just how the ship will land and brace myself accordingly. If a plane is swung into a side slip just before reaching the ground, in a crash, injury can sometimes be avoided. The crumpling wing breaks the shock. In my sixteen years of flying, I have had four bad crashes. And I have walked away each time.

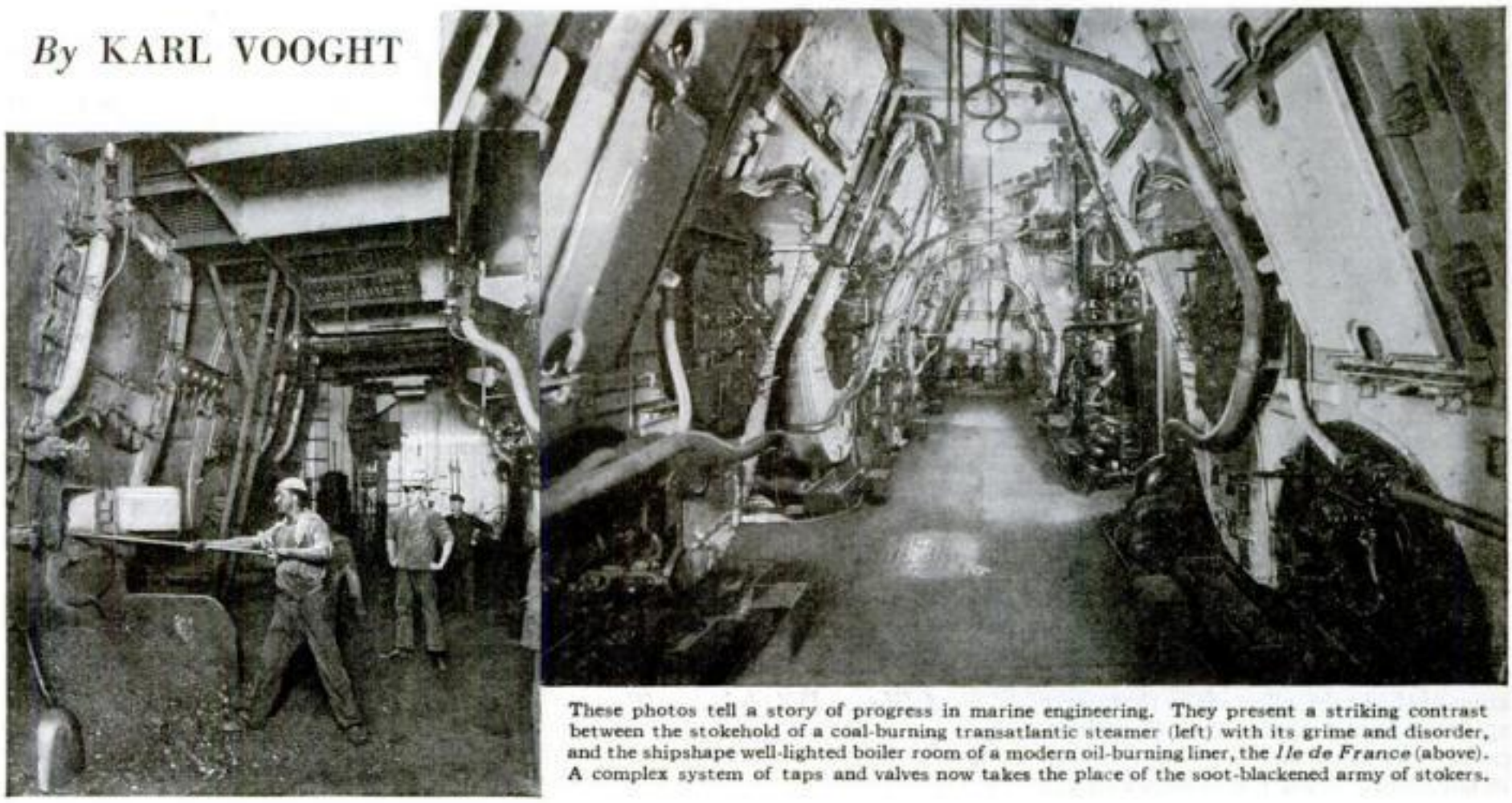
As soon as possible get away from a crashed plane. Fire is still one of the great hazards of aviation. While flying, a pilot should glance at his instruments every two or three minutes to keep track of the motor. An overheated engine may cause a fire in the air—the dread of all flying men. In some instances, it is well to cut the motor high in the air, giving it a chance to

"Bombers circled above trying to destroy the ship. The farmer helped me drag brush to cover the plane. The camouflage saved it."

(Continued on page 147)

Back of the Month's News

By KARL VOOGHT



These photos tell a story of progress in marine engineering. They present a striking contrast between the stokehold of a coal-burning transatlantic steamer (left) with its grime and disorder, and the shipshape well-lighted boiler room of a modern oil-burning liner, the *Ile de France* (above). A complex system of taps and valves now takes the place of the soot-blackened army of stokers.

World's Most Accurate Portable Timepiece

RINGS of crystal quartz not much larger than finger rings form the hearts of the most accurate portable timekeepers yet devised. Developed by Dr. W. A. Marrison, of the Bell Telephone Laboratories, New York City, the new device has operated as a precision clock, week in week out, with a daily error of less than one one-hundredth of a second. This is better than the precision of many clocks used by astronomical observatories, although not quite so good as the best of the mechanical timekeepers available to astronomers.

The utility of Dr. Marrison's instrument is expected to be the fact that it is portable, which the best astronomical clocks certainly are not. To insure precision the latter must be placed inside air-tight cases and set on stone or cement pillars resting on virtually vibrationless rock. Sometimes these clocks are even put in deep wells underneath astronomical observatories to minimize vibration and change of temperature. The new crystal clocks, on the other hand, may be carried on a ship, automobile, or even in aircraft. Temperature changes affect them but can be compensated. To the hazards of vibration they are immune.

The crystal clock depends upon the facts of piezo-electricity, like the vibrating quartz crystal now used to keep radio broadcasters on assigned wave lengths. Exposed to electric stresses, any quartz crystal tends to vibrate at definite frequencies. Dr. Marrison selects crystals which vibrate, for example, at exactly 100,000 times per second. Connected electrically with one of these crystals is a vacuum tube circuit which serves to keep the crystal in vibration and which is held by the crystal to oscillation at precisely the same frequency, say 100,000 cycles per second. By other vacuum tube apparatus already known to radio experimenters Dr. Marrison then reduces this 100,000-cycle frequency to a frequency of precisely 1,000 cycles per second. This second frequency operates the clock.

The new crystal clock, most accurate portable timepiece in the world. Its error is less than one one-hundredth of a second a day. It is controlled by vibrating rings cut from crystal quartz (lower photo).

Certain precautions are necessary for extreme precision. One of them is to avoid temperature change or its effects. This is the reason for using a ring of crystal quartz instead of the more conventional flat disk or square plate. The ring shape is less sensitive, it is found, to temperature changes. Air pressure and humidity need also to be controlled inside the glass case housing the vibrating crystal, for even a thin film of moisture on the surface of the crystal ring would alter the rate of the crystal's vibration.

A New Anesthetic

IN SEARCHING for a poison, two University of Toronto, Canada, biologists, G. W. H. Lucas and F. C. Henderson, recently discovered a new general anesthetic, cyclopropane. Tested upon animals, this gas is said to have proved superior to chloroform for certain kinds of surgical work. The animals returned to consciousness more quickly and with fewer after effects than when given the older anesthetic.

Ever since Davy introduced laughing gas, a hundred and thirty years ago, experimenters have been seeking more effective means of producing unconsciousness without harming the human system. In 1831, three men, Guthrie, of Sackett's Harbor, N. Y.; Soubeiran, of France; and Liebig, of Germany simultaneously discovered chloroform. In an operating room at Edinburgh, Scotland, it was first used in 1848. Two years before, ether had been administered for the first time.

All general anesthetics affect the human system in much the same way. They have a strong affinity for nervous tissue. Chloroform, for instance, collecting in the

At the "gas" station—soldiers filling the tank of the wood-burning Army truck with wood-block fuel. The new "gas" produced by the burning blocks is said to result in 70 percent fuel economy.

tissues of the brain, affects it so that nerve impulses do not pass through. Consciousness returns when the blood has removed the chloroform from the tissues and the brain and nerves resume functioning.

An anesthetic affects only the voluntary nervous system, unless an overdose is given, while a deadly gas deadens the involuntary nervous system, controlling breathing and heart action.

U. S. Army Truck Runs On "Gasogene"—Wood Fuel

AT THE Presidio in San Francisco recently United States military authorities tried out an Army truck running on a new fuel system burning wood. The combustion outfit somewhat resembles a furnace. Wood blocks are burned in an open container, the fumes given off pass through four cylinders, and emerge as gases which, carried to the engine, are there exploded like ordinary gasoline. "Gasogene" is the name given to this new fuel product from wood which has been worked out by Lieut.-Col. Ernest Imbert, a retired French Army officer.

It represents the latest development in the scientific search for efficient substitutes for gasoline as motor fuel. Experiments have been made with alcohol engines; with methanol, a wood alcohol made from coal and water; and with ethyl alcohol, the alcohol of bootleg. A fuel from electrically heated vegetable oil has been suggested by a Russian named Makhonine. Professor Franz Fischer of Germany has experimented with the artificial production of gasoline. Dr. Friedrich Bergius of Heidelberg has combined compressed hydrogen directly with coal paste to make alcohol.

So far as is known, Switzerland alone is to try out "gasogene" on a large scale. Gasoline has recently been quoted there at forty cents a gallon.

While an economy of seventy percent was effected by the new gas it may be useful only for vehicles maintaining uniform speed.

A Tree Within a Tree

NATURE'S freaks usually are the least expected. Roaming his orchard a few weeks ago, Cook Walker, of Laytonsville, Md., singled out a York Imperial apple tree thirty-five years old ready to cut for fireplace wood. He felled it and laid it on the block. When he made the first lengthwise chop into the log, to his astonishment out popped from between the two halves of the log the original nursery tree from which the aged apple tree had sprung. The nursery sprig, though long since dead, had kept its identity through the years, and was lodged within the matured tree like a stick in a lollypop.

That the original sprig was dead there could be no doubt. Only three quarters of an inch in diameter, it bore the knife marks made on the stubs of its branches thirty-five years before, and it retained the knots made when it was pruned at that time. Puzzled, Walker took a cross section of tne entire apple trunk to the Bureau of Plant Industry at the United States Departmeny of Agriculture, where L. C. Corbett, the principal horticulturist, unraveled the mystery.

The question to be answered was: How could a tree grow and attain size when the top of the nursery tree from which it developed died soon after planting? Horticulturist Corbett's explanation of the riddle was adroit. The wood of the young tree, which included the woody fibers of the trunk, died, he claims. But the cambium, which may be called the perpetually youthful tissue of the tree, and which in receiving the plant food by ducts from the leaves builds up the woody fibers and the bark, remained alive. Hence this cambium portion was still capable of cell division, and went on creating woody rings which eventually became the trunk of the full-grown orchard tree cut down by Walker. This process also accounts for the absence of any bark on the dead nursery sprig. The nutrition of the tree, says Corbett, must have entered through vessels in the dead wood of the sprig, which still continued to act as conductors of sap.

Original nursery sprig taken from the heart of an apple tree, where it was preserved for 35 years. The sprig (B) was in the cavity shown at A-C-D. It was found to be dead.

World's Largest Shovel

A MONSTER electric shovel, which can lift 100 tons—the weight of a medium-sized locomotive—to the height of a seven-story building, began a Herculean job recently when the Fidelity coal mine, Du Quoin, Ill., was opened.

Largest in the world, the excavator was designed for a capacity of twenty cubic yards. For its present use, however, the capacity of the dipper has been reduced to fifteen cubic yards. This allows for an extension of the boom, which gives the shovel a greater reach. In one bite, it can scoop up a load of material sufficient to fill a bathroom, or enough coal to heat a good-sized dwelling for an entire year—about sixteen tons. Doing this and dumping its heavy burden takes less than one minute.

Weighing approximately 1,600 tons, which is twice as much as the biggest shovel previously made (the ordinary type used in city excavation work weighs about thirty tons), it is equipped with a twenty-ton crane for handling its machinery. Its electric equipment has a capacity of about 4,500 horsepower. Yet one man can control all of its operations.

With this and many other pieces of modern electrical equipment, including a tipple that serves seven railroad tracks, the company controlling the Fidelity mine expects to mine and handle 1,500,000 tons of coal a year.

Large though this output may seem, it is a drop in the bucket compared with the total annual coal production of the United States, the greatest coal country on earth. In 1927, the latest period for which figures of the United States Bureau of Mines are available, 545,000,000 metric tons were mined here (a metric ton is 2,204.6 pounds). Roughly, this would be sufficient to erect a black duplicate of the wall of China around the country, and the coal would contain

enough power to lift that wall 200 miles.

Germany, in 1927, yielded 304,400,000 metric tons, and the United Kingdom was third with 259,500,000. The world's total production for the year was 1,475,000,000 metric tons.

While this is an enormous harvest, the world's coal supply shows no signs of exhaustion. At the present rate of consumption, the earth still holds enough fuel for about 5,000 years.

Hearing without a Sound

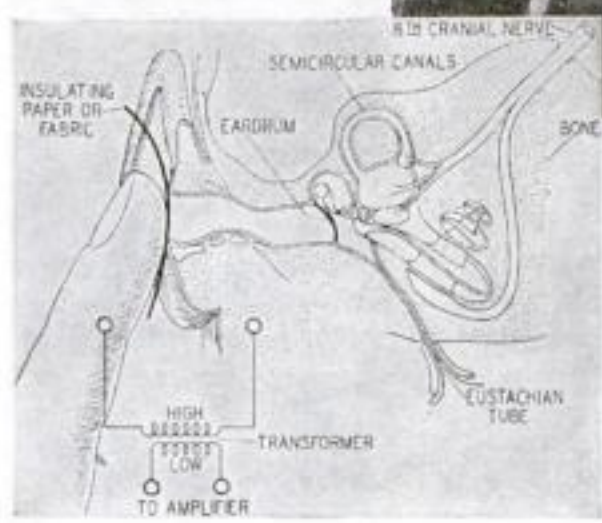
HEARING with an eardrum vibrated by electricity instead of by sound waves, a man in New York City recently listened to music inaudible to other members of an audience witnessing a demonstration by Dr. Sergius P. Grace, of the Bell Telephone Laboratories. Dr. Grace was connected electrically to a powerful vacuum tube amplifier. When he placed a finger tip against one ear of a member of the audience, using a sheet of paper as insulation, the effect was to produce a condenser type loudspeaker with the finger tip as one pole and the eardrum and surrounding flesh as the other. This vibrated the drum of the stopped-up ear just as though sound waves were reaching it.

The experiment, which appears to have no practical value at present, demonstrated a novel way in which sound may be directly transmitted to the eardrums other than by ordinary sound waves. Every sound ordinarily heard, from the humming of a gnat to the crashing of thunder, reaches the ear through vibrations of gases or solid substances. Light, heat, and radio waves pass through the ether. Sound waves cannot travel through a vacuum. They require gases or solid substances as a medium of travel.

Vibrations that create sound are produced mechanically in several ways. In the phonograph, the needle, following the up-and-down or the side-to-side waves in the groove on the record, moves the diaphragm of the instrument. In the telephone, the diaphragm of the receiver is vibrated by electrical impulses coming over the wire. In talking movies, light and dark bands on the film allow varying amounts of light to reach a photo-electric cell. This transforms the variations of light intensity into electrical impulses which move a diaphragm as in a telephone.

One of the latest uses for the last method was also demonstrated by Dr. Grace recently in the form of an instrument that makes audible the numbers called on a dial telephone. When a number is dialed the operator hears it announced vocally. Small reels of talkie film contain a voice record of the numerical units from zero to ten. These reels turn automatically to the numbers corresponding to those dialed by the caller. By a mechanism similar to that used in talking movies, the numbers are made audible.

"Electrical hearing" demonstrated by Dr. Sergius P. Grace, of the Bell Telephone Laboratories. Connected electrically with a powerful vacuum tube amplifier, he places a finger tip against the subject's ear, after inserting an insulating sheet of paper between. The result, as shown in the diagram below, is to form a human loudspeaker of the condenser type, in which the eardrum is one of the vibrating poles.



Dr. Grace with the new instrument which makes audible numbers dialed on an automatic telephone.

The world's largest coal shovel holds a motor car. One scoopful would fill the average bin with coal.

How Birds and Flowers Get Their Colors

FOR the first time, the beauty of field and garden has been put on a quantitative, scientific basis. Actually charting the colors of cosmos, rose, and gladiola is the feat recently accomplished by Dr. Samuel G. Hibben, of the Westinghouse Lamp Company. He recorded the hues of these flowers with a spectrophotometer, an instrument that analyzes the composition of tints, to show how Nature compounded the colors. The pink tint of the briarcliff rose, for example, turns out to be a mixture of a little blue, some green and yellow, considerable orange, and nearly as much red.

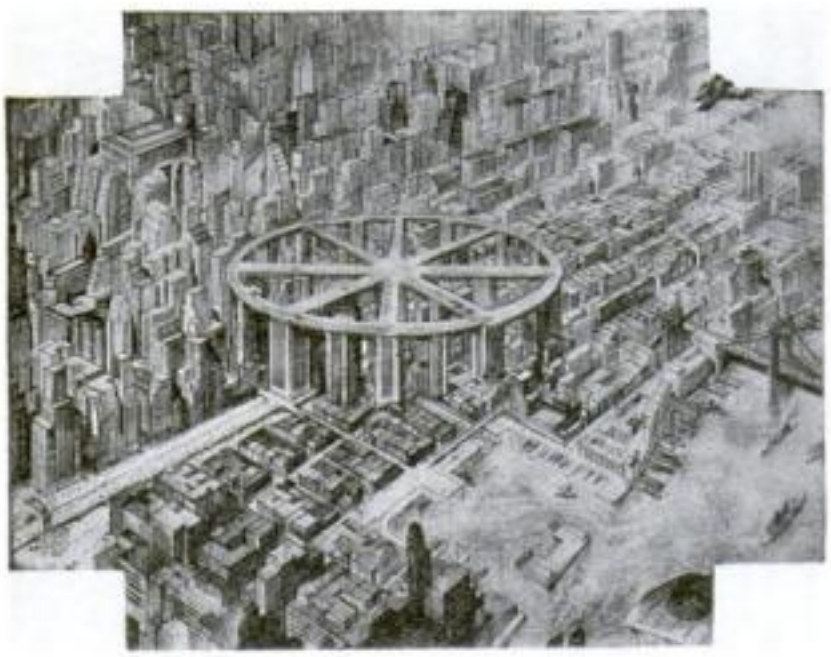
(Continued on page 146)

How Much Do You Know About the Human Body?

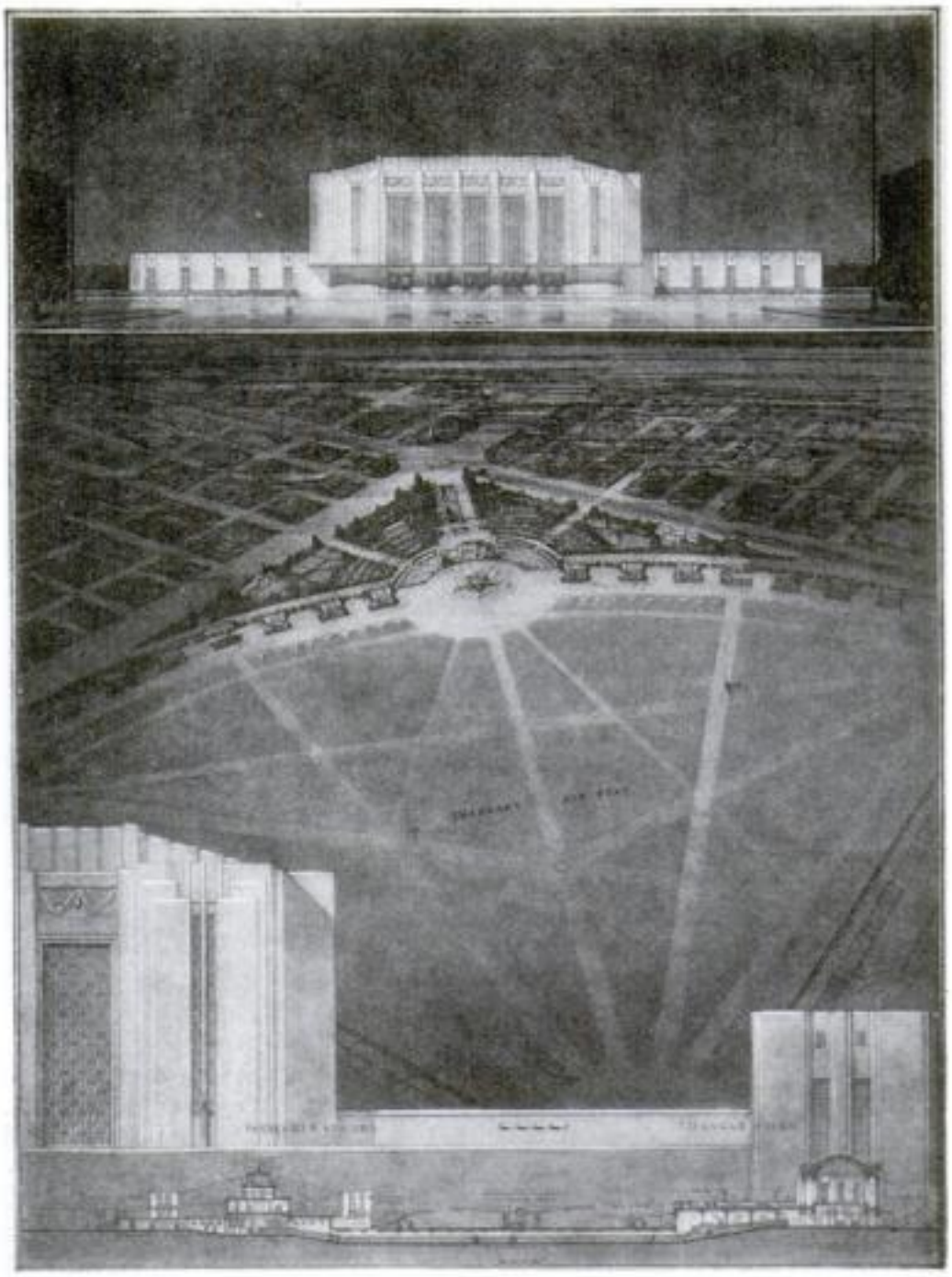
TEST your knowledge with these questions, chosen from hundreds asked by our readers. You will find the correct answers on page 150.

1. **How do you keep your balance?**
2. **What makes you sneeze?**
3. **What makes muscles work?**
4. **Why do some people grow so tall?**
5. **What causes rheumatism?**
6. **What makes the heart beat?**
7. **What does it mean when they say a runner or athlete has his "second wind?"**
8. **Has a nervous, high-strung person too much nervous energy?**
9. **How do poisons destroy life?**

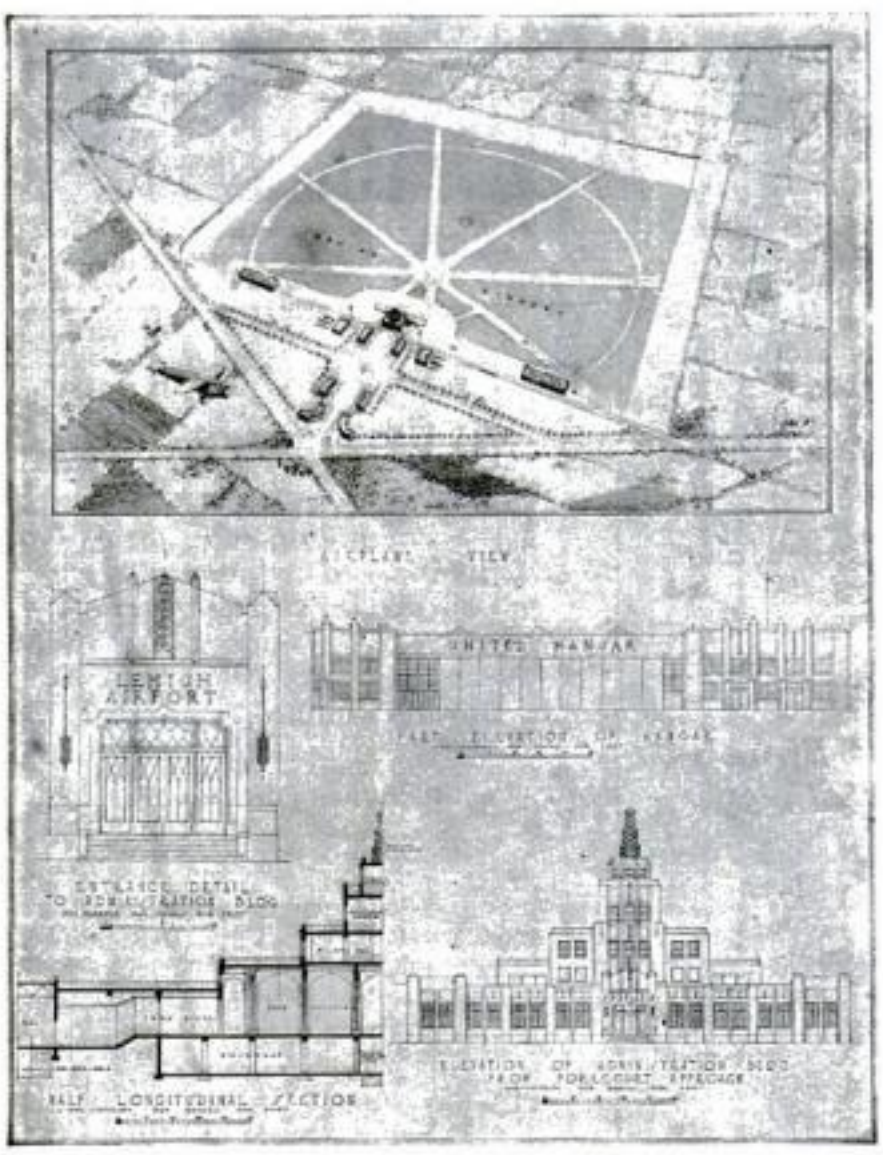
Airports for the Future



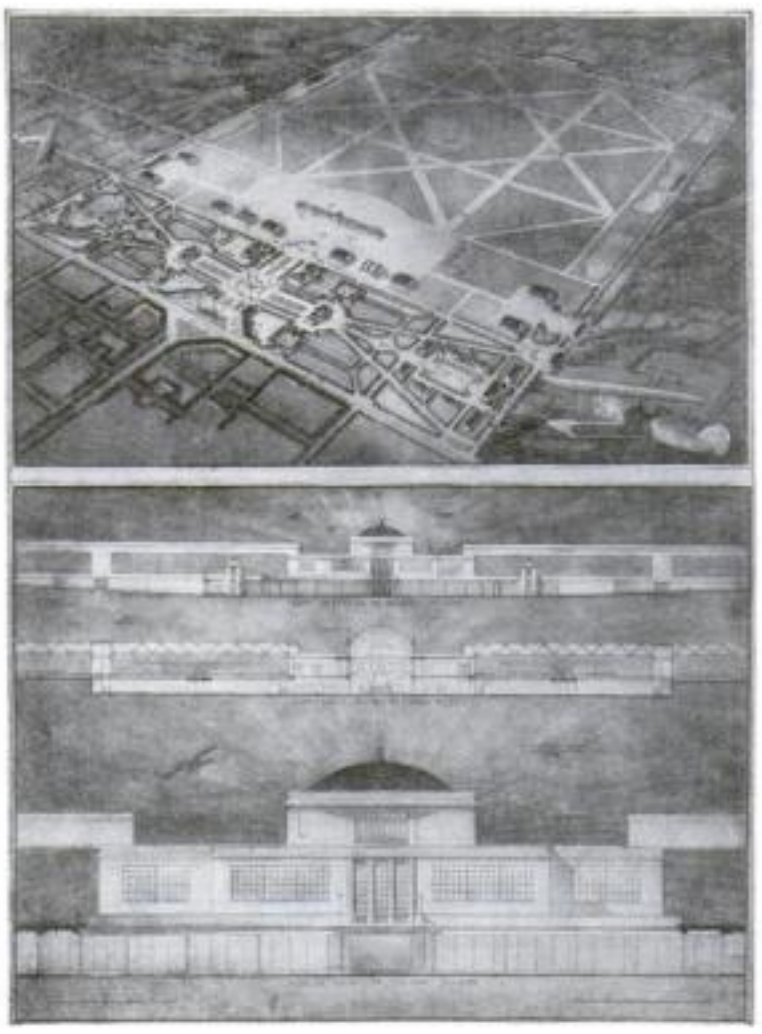
Like a huge wheel resting on skyscraper roofs is this city flying field designed by H. Altvater, of New York City. It is one of many ingenious plans submitted in the recent prize competition sponsored by the Lehigh Portland Cement Company to develop practical designs for city airports.



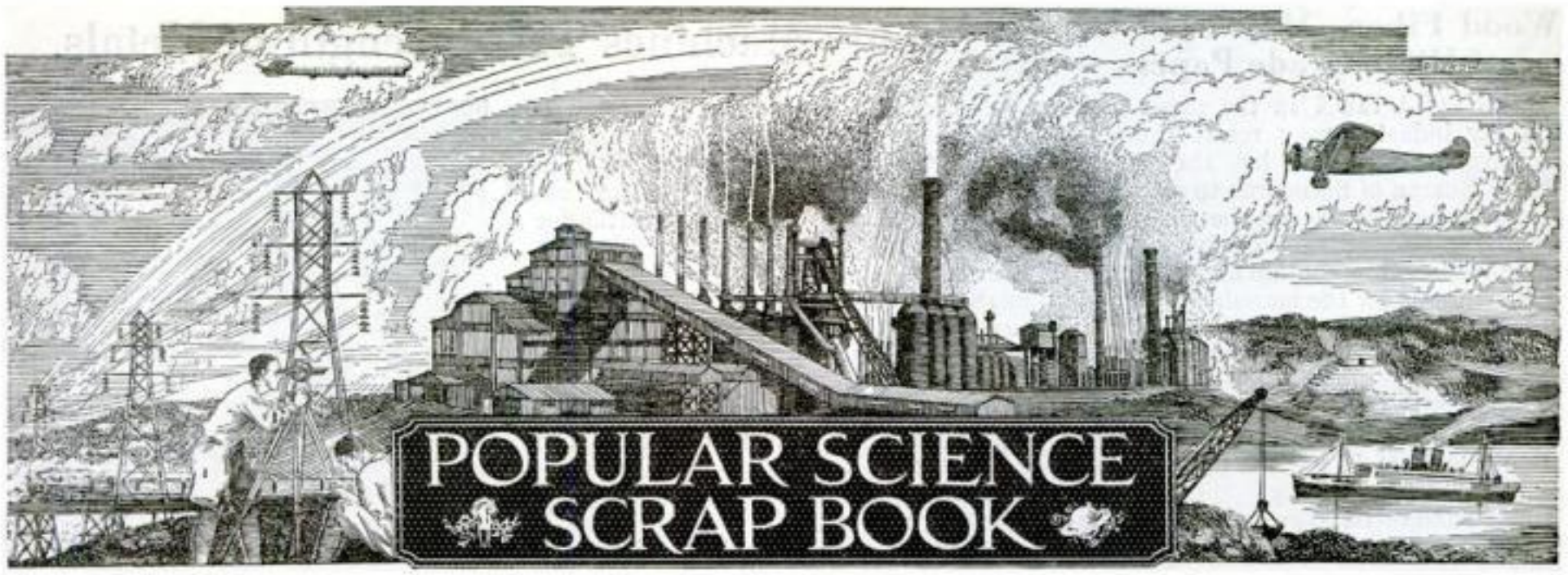
First-prize winner, designed by A. C. Zimmerman and William H. Harrison, of Los Angeles, Calif. Buildings are in one corner of a rectangular field, leaving a quadrant-shaped flying area with runways and taxi strips. The passenger terminal building (top) is flanked by hangars at edge of flying area. The bottom view shows provision for underground access to loading and unloading points. Auto parking spaces, a hotel, shops, etc. are in a triangular park.



Second-prize winner—a rectangular field with buildings grouped along one side. The spokelike runways are connected by a circular taxiing strip. The passenger terminal building is flanked by loading platforms. Planned by C. Gifford Rich, Chicago, Ill.



The third-prize winner, at right, was planned by Odd Nansen, of East Orange, N. J., and Latham C. Squire, of New York City. Terminal buildings, at one side of the field, are adjacent to a plaza.



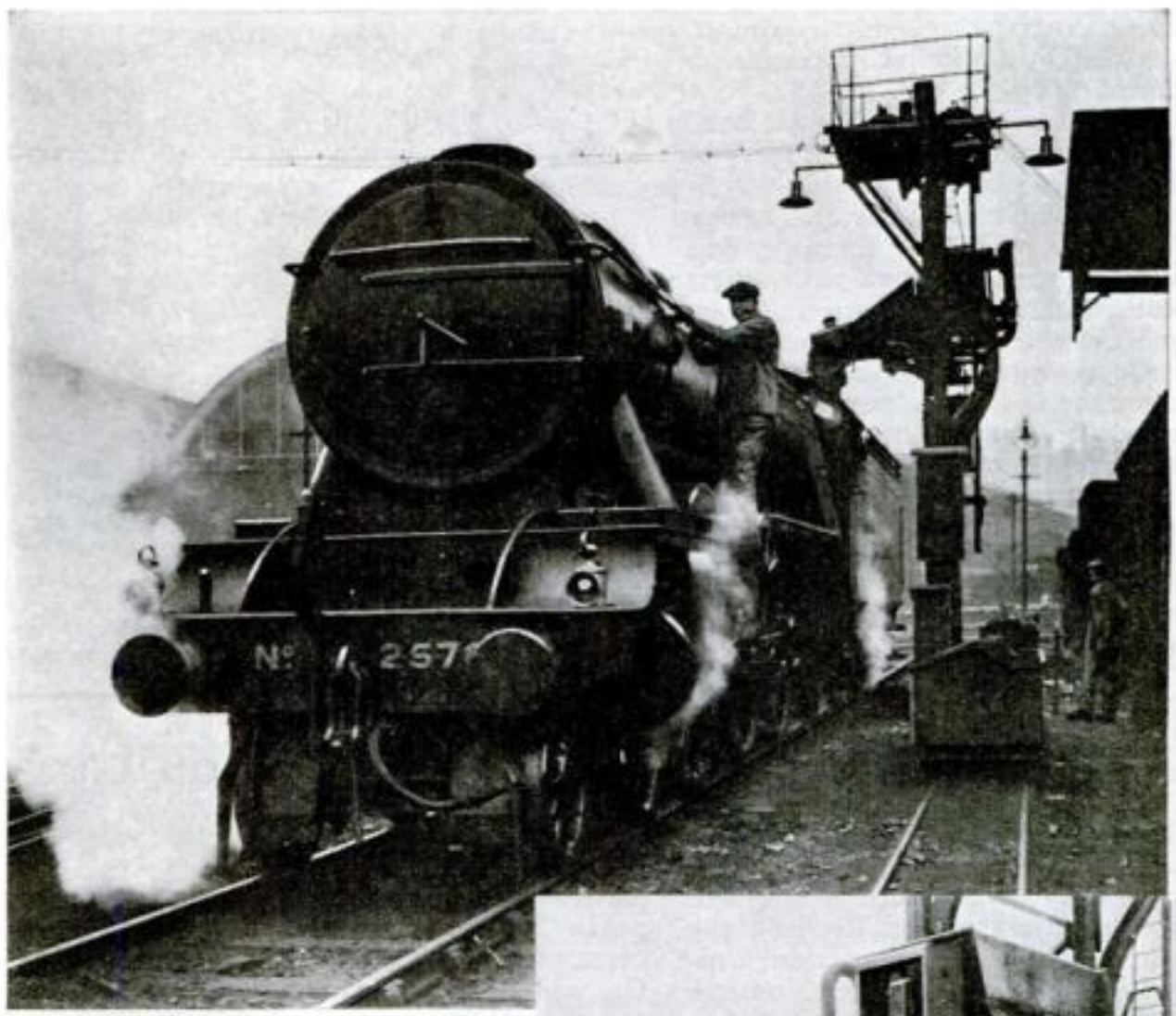
On the following pages are presented a month's record of invention and brief bits about the new, interesting, and unusual things people are doing in all parts of the world.

Electrified Coaling Station Feeds Locomotives

A TIME and energy saver of unusual efficiency has been introduced into railroad yards of London, England. A scene which is becoming familiar at King's Cross Station is the coaling of a giant locomotive within fifteen minutes, by an electric elevator. This new yard machine can be operated by one man and can feed fifty engines a day.

The work of coaling a locomotive is performed in three simple operations. First, a small truck loaded with coal runs into position on a separate track under the two staunch arms of the elevator. Next, the piece of track on which the truck stands acts as an elevator floor, and lifts the truck, together with a chute fitting above it, up a shaft to the proper height above the waiting locomotive. Lastly, by a combined movement, the chute and truck swing through an arc to a point directly over the locomotive tender. The chute can now receive the coal from the truck and empty into the tender, a single electric control managing the entire operation.

The arrangement kills two birds with one stone, for while the engine is being coaled it stands over a working pit wherein mechanics may oil wheels, clean out grit, and give the running gear of the locomotive a thorough inspection.



An English locomotive receiving coal from the chute of the elevator. At right: One-man operation. Note loaded and empty trucks.

Gems Fourteen Feet Long

ROCK crystals as long as an automobile were recently uncovered in a quarry near Albany, Maine. The remarkable columnlike structures of beryl measured from twelve to fourteen feet long and from two to three feet thick. A movement is on foot to obtain the gigantic semi-precious stones for preservation in a museum.

Beryl is a silicate rock, commonly green or bluish green, but sometimes found with yellow, pink, or white tints. From it the rare metallic element, beryllium, is obtained. This extremely light metal has been valued at nearly $200 a pound. Geologists estimate that there is as much beryllium in the earth's crust as there is lead or zinc. Aircraft designers have been conducting tests with the rare metal, which may find an important place in aviation.

Wood Fibers May Cut Cost of High-Grade Papers

A REVOLUTION in the paper making industry may result from experiments conducted by the United States Bureau of Standards to show that certain wood fibers can be chemically treated to remove the excessive amounts of impurities they contain and thus make them suitable for the manufacture of the high-grade, durable papers used for permanent records. If the process is a success, a great saving will be effected, as wood fibers are much cheaper than cotton and linen fibers. Books and magazines would attain a much higher degree of physical permanency.

Linen and cotton rags, containing cellulose comparatively free from impurities, produce the grades of paper used for records and good stationery. They are boiled in chemicals, shredded into a pulpy mass, bleached, and dried. Paper for books and magazines is manufactured from pulp produced by cooking chips of wood in chemical solutions, which remove most of their impure elements and leave the cellulose fiber. "Newsprint"—the paper used for newspapers and cheap magazines—is also made of wood pulp. This, however, is not chemically treated but produced by a grinding process under running water.

To determine the durability of wood pulp paper made by the Bureau of Standards process, chemical analysis alone is not sufficient. Accelerated ageing tests are made by heating the paper and finding the degree of deterioration of its physical and chemical properties. Among the processes employed in these artificial ageing experiments are the dry baking of the fibers at a temperature of 212 degrees F., cooking them with steam, and exposing them to intense light rays from a carbon arc lamp, used as a substitute for sunshine.

Two New Vitamins Found by Women Chemists

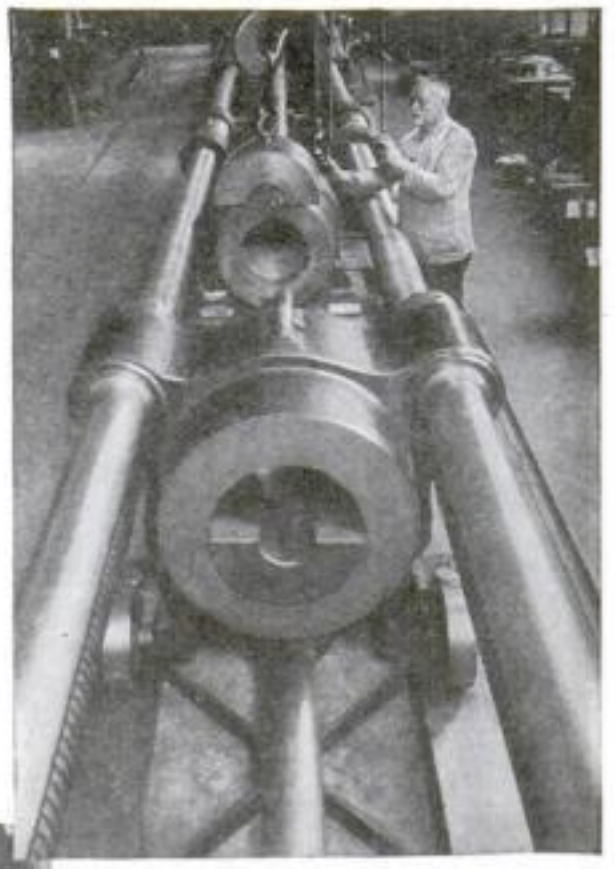
UNTIL a few weeks ago the world's biological chemists had let two vitamins escape unnoticed. News has come from London, however, that Katherine Hope Coward and her colleagues at the Laboratory of the London Pharmaceutical Society have captured one of these chemical eels, and that Vera Reader of the Biochemical Department at Oxford University has captured the other. No name has been given to the first. It is found in fresh milk, lettuce grass, ox muscle, liver, and wheat embryo. It is vital to that present-day scientific pet, the experimental rat, but it is not known yet whether it is vital to man.

The other is found to be a new sister of the vitamin B family. Originally this vitamin was a lone brother, the lack of which was held responsible for beriberi, the Oriental neuritis of ancient lineage. Then chemists divided it into a brother and sister, B1 and B2. Now Miss Reader has brought a third entity, vitamin B3, into the limelight. It is similar to its sister B2 in that it is thermolabile; that is, it can be easily destroyed by heat. Vitamin B has acquired special distinction because of its presence in yeast.

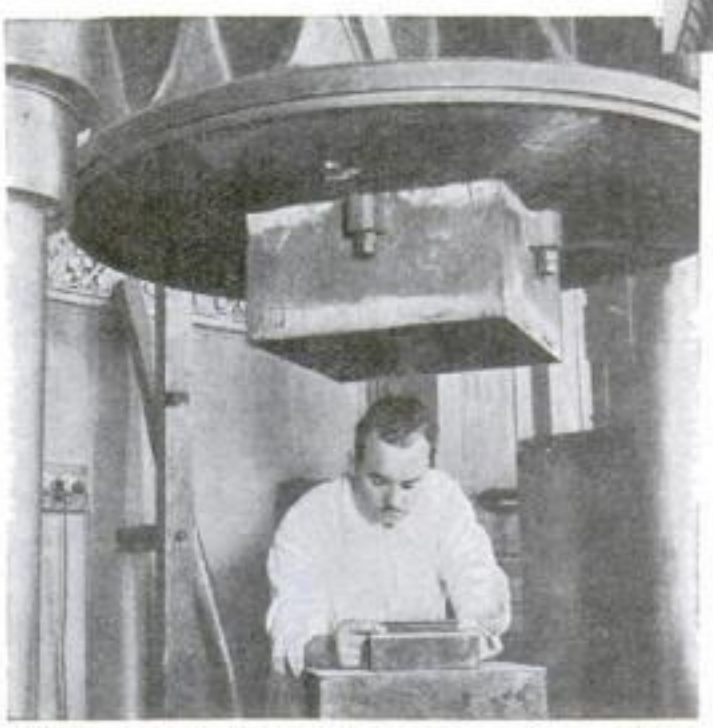
Mighty Machines Test Strength of Metals

AN OCEAN liner many times as powerful as the *Leviathan* could be dragged backward through the water, in spite of churning propellers, if it were attached to a giant pulling apparatus for testing metals recently installed in a laboratory at Berlin, Germany. The mighty screws of this machine are said to exert, at their greatest pull, a force of more than 6,000,000 pounds. Another apparatus in the same laboratory is reported to be able to press with the steel-crushing force of 1,250,000 pounds. The two machines are used to test the resistance of various metals to pull and pressure, respectively.

Using a similar squeezing machine, not long ago, Dr. Percy W. Bridgman, at Harvard University, Cambridge, Mass., achieved what is believed to be the highest pressure ever attained in a laboratory —600,000 pounds per square inch. At this pressure, which is equal to that on the bottom of an ocean 250 miles deep, steel would flow in a semi-liquid state, oil would become as solid as wood, and paraffin as hard as steel.



A pull of six million pounds is possible with this giant metal-testing machine. Powerful screws "stretch" steel girders.



Placing samples of steel under the pressing machine which exerts a crushing force of a million and a quarter pounds. Such tests may throw light on atomic changes resulting when metals are placed under great pressure.

The plunger of Dr. Bridgman's machine operated in a hole in a huge block of steel. Once, under maximum pressure, the walls of this solid steel chamber broke in such an explosive manner that fragments penetrated six inches of pine planking. These particular experiments were made to test materials to be used in the manufacture of big guns. It is planned to continue them to study the molecular and atomic changes that result when metals and other substances are placed under great pressure.

Looking Down on Largest Dirigible Hangar

THIS aerial photograph of the mammoth Goodyear-Zeppelin hangar under construction at Akron, O., was taken during the recent ceremonies marking the beginning of work on the United States Navy dirigible *ZRS-4*. Built to accommodate what will be the world's largest lighter-than-air craft, the hangar is capacious enough for three football games to be played simultaneously within it. The actual dimensions of the hangar are 1,175 feet long, 325 feet wide, and 211 feet high at its greatest point. Its floor space is 364,000 square feet.

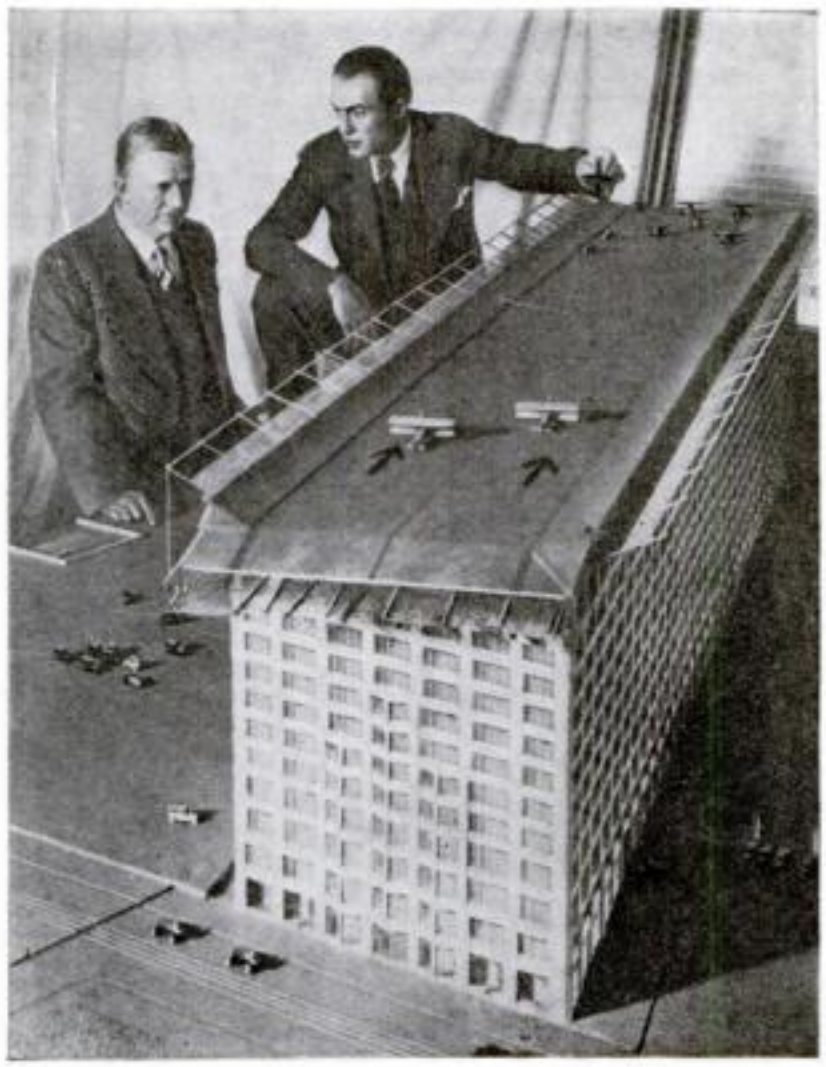
Spectators watching Rear Admiral William A. Moffett drive the first rivet of the new Navy dirigible *ZRS-4* look like a swarm of tiny ants.

Scale Model Shows Plan of Roof-Top Airport

PLANS for a $10,500,000 air terminal building for Los Angeles, Calif., which will include a roof-top landing field nearly 1,000 feet long, have been embodied in a realistic model of the building prepared under the direction of O. R. Angelillo, chief engineer in charge of the project.

Built exactly to scale, the model shows a twelve-story structure surmounted by a level roof 152 feet wide and 980 feet long designed and equipped as an airport. On all four sides of the roof are banked screens of steel netting to guard planes from plunging off—a plan similar to that used on the United States Navy's airplane carriers *Lexington* and *Saratoga*. The screens at each end are arranged so that they can be lowered for landings, according to the direction in which the wind is blowing.

Toy planes are placed on the model field to demonstrate how ships will land and depart.



Model of proposed $10,500,000 air terminal building for Los Angeles, with landing field on roof. The two planes in foreground are represented as landing in direction indicated by arrows.

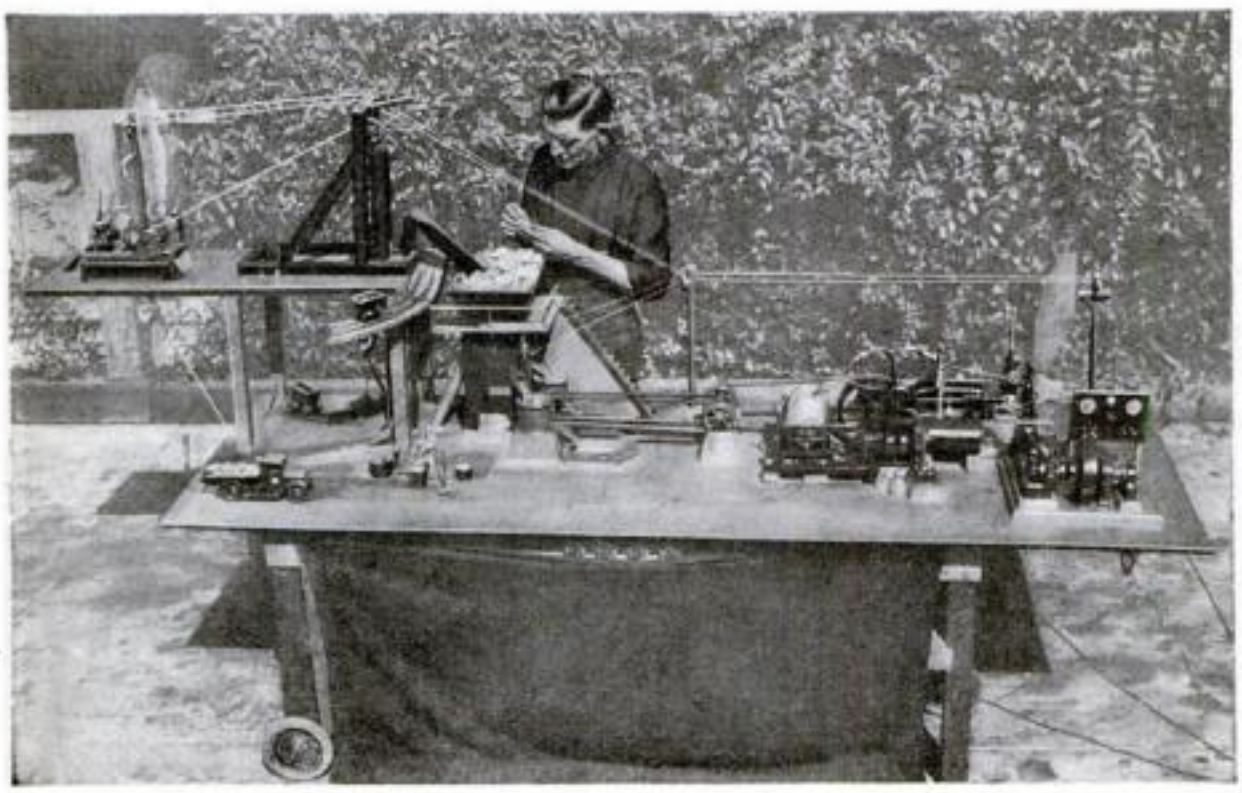
Back-Yard Inventor Builds Mining Machine

A LABOR-SAVING machine that saved no labor for its inventor was completed recently by Thomas G. Duncan, of Los Angeles, Calif., after six years of work. Duncan's apparatus is an electrical working model of machinery designed for use in mining operations. Each one of its 186,000 individual pieces was turned by hand on a sixteen-inch lathe, the patterns for them being cast and made in the inventor's back yard.

The machine itself is designed to perform almost all the operations required in mining. In mines where a full-sized machine is installed, the inventor claims, five men will be able to perform work ordinarily requiring at least twenty-five men. The machinery itself may be operated by one man.

Duncan is himself a veteran mining man. He spent twenty-two years in Mexico in mining operations and is said to have been the last American to leave the country during the revolution of 1910.

The photograph below shows Duncan demonstrating to friends the operation of his miniature system of mining apparatus.



Completed after six years—Thomas G. Duncan with the model of his labor-saving machinery for mining operations, in the back yard of his home at Los Angeles. The machine contains 186,000 pieces.

Finds Men Are Hurt More Easily Than Women

IN EXPERIMENTS to determine the nature of pain, Prof. Uginelli, of Florence, Italy, has found that the cheek and the forehead are by far the most sensitive skin territories of the body, while the outer arm is by far the toughest. This toughness can be explained by centuries of wear and tear to which the arms have been subjected in maintaining the body defenses. Prof. Uginelli has discovered also that women are one tenth less sensitive to pain than men.

Pain is one of the mysteries of medical science. About all that physiologists know concerning it is that when the little nerve cells in the skin are excited in a certain way, as in a stab or prick, the result is painful.

Mysterious "Onion Rays" Cause Cells to Grow

RAYS emitted by growing onion roots stimulated the growth of cells from a frog's eye in a recent laboratory experiment conducted by a Swiss biologist, Dr. Andre Naville. His test confirmed the earlier discovery of the mysterious "onion rays" by a Russian biologist, Dr. A. Gurvitch. Further experiments will be made to find out if the rays have the same effect upon other living cells.

It is estimated that a man of average size has 25,000,000,000,000 cells in his blood stream alone. In his whole body there are at least five times this number. An interesting comparison of the total surface area of the cells in a body with the area of the body itself has been made by biologists at Stanford University, Calif. If a cubic-foot block of wood is sawed into cubic-inch blocks, the combined surface area of the smaller cubes is twelve times greater than that of the original. Applying this principle to the human body, the Stanford biologists concluded that the surface area of its cells would total not less than 170,000 square feet. This is more than 10,000 times greater than the area of the average human body, which is approximately sixteen square feet.

Disease Stops Mice from Conquering the Earth

A BIOLOGIST once computed that if oysters were allowed to reproduce without check, they would swamp the whole earth inside of eight years. Now Charles Elton, zoologist of Oxford University, England, has stated that if the mouse population did not suffer a periodic decrease, the situation for mice would be similar to that for oysters. He says that ten years of uninterrupted increase on the part of a dozen pair of the "cheese-eaters" would cover the face of England with a thousand billion of their children. It is some sort of disease, he says, which calls a halt to their terrible reproductive powers.

Similar cycles are claimed for other creatures. One of the well-known prophecies of entomologists is that the entire world of animal life will be eventually dominated by insects.

Finds Germs Change Hands with Every Clasp

THE alleged Chinese custom of shaking hands with one's self instead of with the other fellow may spread over the world if sanitary experts have their way.

Bacteriologists and physicians often insist that disease germs may be communicated from one person to others by a handshake. Recently Miss L. I. Given, research student at Columbia University, put the matter to a test. Several students had their hands thoroughly scrubbed and disinfected. The hand of one student was then contaminated by a living bacteriological culture. This student shook hands with three others, who, in turn, shook hands with others, and so on until all experimenters had had their chance at acquiring a germ. All hands were then tested for living germs.

Germ transfers may go as far as the sixth or seventh person in such a handclasp chain, Miss Given found. Germs of typhoid fever, tuberculosis, diphtheria, and cholera are among the organisms thus transferable. Apparently the only safeguard against infection is the fact that nearly all germs are relatively fragile and die on exposure to sunlight and air.

There has so far been no call for volunteers to test the theory that germs are also spread by kissing.

New Fishing Boat Freezer Keeps the Catch Fresh

WHALE and walrus meat, centuries old and buried in glaciers, has often been found in such an excellent state of preservation that it would make palatable roast steak for dinner. A new type of fishing trawler, however, that will do the work of the glacier for ordinary fish within four seconds, recently made its trial trip at Kiel, Germany, and is expected to revolutionize deep-sea fishing methods. It carries a refrigerating plant by which the fish, dipped into a salt solution of four degrees Fahrenheit, in no time are frozen stiff as wood; at the same time the fish are coated with crystallized salt.

Thus preserved without a fiber spoiled, fish can be kept nine months without altering the taste and in as firm a conditon as fresh fish.

This Farm Raises Herds of Corn-Fed Worms

FISHERMEN need no longer fear that droughts will cut off their supply of bait, in view of a great angleworm farm which is now in the process of rapid growth at Alhambra, Calif. With a crop which for only six months reached the figure of 300,000 worms, this novel industry may challenge the raising of citrus fruits in that state for a place on the map.

Since the wholesale production of earthworms had its birthday at Alhambra four years ago, the output of the farm has been steadily increasing, until now it is estimated that its crop could care for half the demand in the United States. Fed entirely on corn meal, these worms often reach the age of twenty. When ready for sale they are moss-packed in tins.

A "Baker" of Wax Turkeys and Sawdust Pies

Painting the finishing touches on an assortment of sawdust and wax foodstuffs.

The "roasted" wax turkey comes out of the mold, to be colored a rich brown by the artist.

The first step in creating an appetite-arousing sirloin steak—pouring hot wax into the mold.

PASTRIES that tempt by their appearance but prove to be filled only with sawdust, and well-browned turkeys whose wax flesh defies the strongest teeth, are among the products that come from the strange kitchen of Herbert Bohrmann, of New York City. They are designed not for the table, but to adorn the windows of delicatessen stores, groceries, and restaurants.

The delicacies go through many processes before they are ready for distribution. First, hot wax is poured into carefully prepared molds and allowed to set in the shapes of steaks, chops, pies, and pastries of all sorts, or even "fresh" vegetables. Then the wax exteriors are removed from the molds and stuffed with sawdust. After this they are prepared for the final stage—the painting of them in "natural" colors. When the artists who attend to this stage of the work have finished, the "foods" are ready to be distributed. So well do the artists apply the colors that, it is said, only close scrutiny reveals the food's artificiality.

Pencil Holds Note Paper—Envelopes Next?

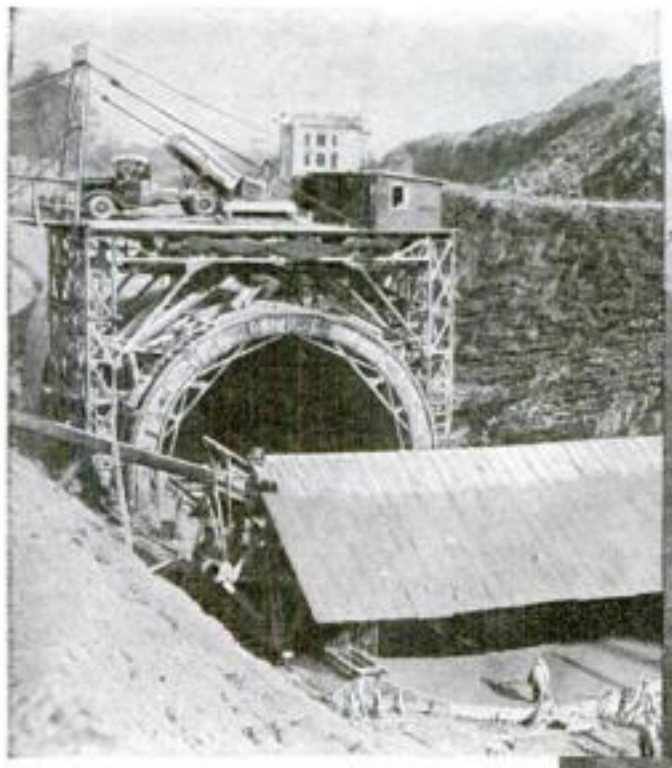
CARRYING a roll of paper in its barrel, a novel pencil from Germany, though no larger than an ordinary magazine pencil, will supply at a moment's notice all the materials essential for writing a note. In addition, it carries extra leads, the lead and the paper being separately operated.

The new pencil with roll of note paper inserted. The edge of the paper can be seen protruding.

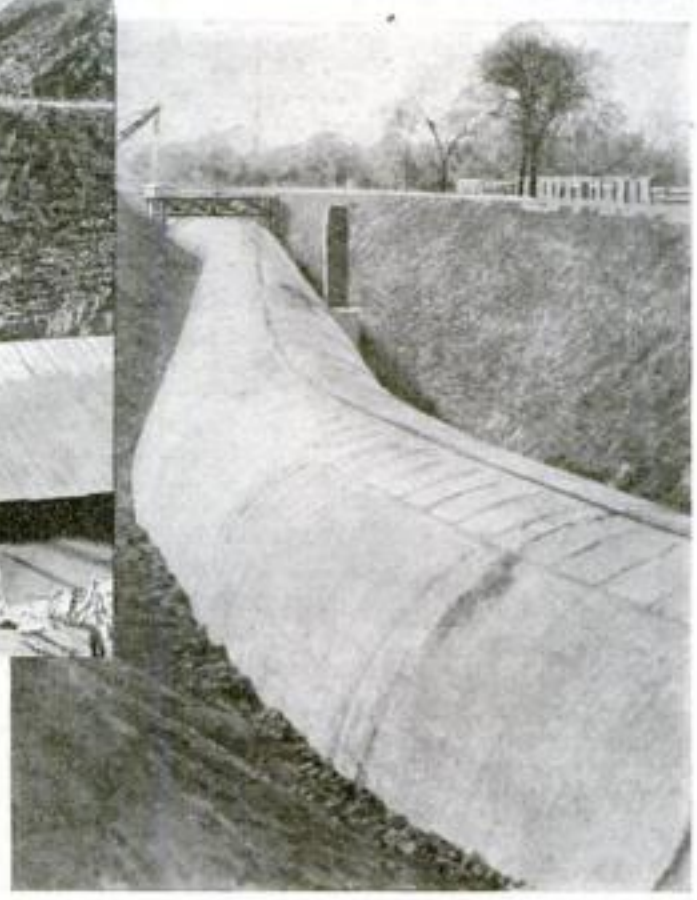
A flap on the side of the pencil is raised to admit a fresh roll, when one is required, and the edge of the paper projects through a slit at the bottom of the flap. The paper may be turned either forward or backward by means of a movable band near the point of the barrel, and any length of paper may be cut off automatically when turned out.

Perhaps some ingenious inventor will now come forward with a pencil which will hold stamps and envelopes as well.

River Imprisoned in Thirteen-Mile Tunnel



Construction work on the concrete tunnel into which the River des Peres will be diverted. Below: A completed section of the tunnel.



THIRTY-THREE giant excavators, some of them digging 8,000 tons of clay in twenty-four hours—more than 1,400 men could dig in the same time, working in ten-hour shifts—are part of the elaborate machinery required to imprison the unruly and malodorous River des Peres, near St. Louis, Mo., in a man-made tunnel and force it to change its course.

The River des Peres is a surface drainage stream draining a 100-square-mile area, 16,000 acres of this being within city limits. Its stench has long been a source of annoyance to St. Louis, and it was for this reason that the work of digging a new course for it and constructing a sewer thirteen miles long was undertaken. The sewer is being built of reënforced concrete, is twenty-nine feet high and thirty-two feet wide, and will cost about $11,000,000. Through it the river will empty into the Mississippi.

"Big Pete," the largest of the thirty-three excavating machines, is powered by a 240-horsepower Diesel engine. Operated by three men, it is capable of digging nine tons of clay at a scoop.

Racing Boat Throws Rider and Leaps Ashore

TOSSING its driver into the water and then charging straight for the river bank, an outboard motor boat came to rest high and dry during a recent race at Rickmansworth, Hertfordshire, England. As the *Invicta II* sped around one of the buoys marking the course in the River Colne, a tributary of the Thames, H. G. Reigate, who was at the wheel, was jerked cleanly out of his seat and left behind. The pilotless craft headed directly for the shore and, as it hit the shelving bank, leaped four feet into the air, to land safely ashore with slight damage.

The spectators, who were totally unprepared for so fantastic an event, scattered pell-mell. All escaped injury. Reigate, little the worse for his curious accident, was picked up by a patrol boat.

The photographer snapped this picture just as the pilotless outboard racer, running wild, climbed the river bank into a crowd of spectators, who are seen scrambling to safety. None was injured.

Lustrous Pearl Buttons from Clamshells

A MORE lustrous and valuable mother of pearl from clamshells for use in the manufacture of buttons is the aim of Professor Max Ellis, a Missouri physiologist and investigator for the United States Bureau of Fisheries. Rejecting Nature's methods as too perilous for the early life of clams, he will raise the young ones in test tubes that can each contain millions of the little buttons-to-be. Taking mature eggs from the female, he says he can grow in ten days great quantities of clams ready for planting in a favorable environment. Left to shift for themselves in the ocean depths, the baby clams would stand about one chance in a thousand of surviving.

The young clams are to be planted in streams just as fisheries are restocked. Here, within five to eight years, may be developed shells worth from $125 to $150 a ton. The new method of raising the clams is expected to give a finer type of shell, with unusual luster.

Habitual Leg Crossers Warned of Palsy

LEG crossing, once a unique privilege of man but lately taken over by women, should be abandoned by everybody, according to Dr. Henry W. Woltman, of the Mayo Clinic in Rochester, Minn., who holds the habit responsible for most cases of palsy. He asserts that the disease, a type of paralysis, is caused by a direct pressure on one of the main nerves in the back of the leg, the peroneal nerve, and that middle-aged persons who are specially devoted to leg crossing are the chief victims.

General inaction and sleeping in distorted postures are cited as closely related causes. Anything which tends to reduce the individual's weight is a factor, as this removes the layer of protective fat about the leg which might otherwise allay pressure on the nerve.

Volcanoes Help to Make the Ocean Salty

WHAT keeps the ocean briny? The 485 known volcanoes of the world, spouting yearly more than a hundred million tons of hydrochloric acid, combine with the rivers to salt the sea. The rivers bring down quantities of sodium which unite with the acid to form sodium chloride or common salt. There are many other salts in the ocean, but ordinary table salt is the principal one. This is the conclusion of Dr. Thomas A. Jaggar, director of the Hawaiian Volcano Observatory at Honolulu, after extensive studies of the subject.

The hydrochloric acid leaves the volcanoes as a gas with the constantly rising steam, Dr. Jaggar explains. The gas merges with water vapor in the atmosphere and falls with the rain. Considering that there is an average rainfall of about forty inches the world over, rain water need contain only about one part of hydrochloric acid in five in order to supply the ocean's salt.

Heated Windshield Wiper Melts Ice on Glass

ELECTRIC heat warms the newest automobile windshield wiper to help it clear snow and sleet from the winter driver's path of vision. In appearance it resembles an ordinary wiper, and is attached in the conventional way. But the jointed metal arm contains a concealed heating coil, connected with wires from the car's battery. Swinging the arms out of its folded position automatically snaps on a switch and generates a gentle heat. The wiper blade, melting the ice on the windshield, sweeps the heated liquid across the glass and clears it.

Sediment in Ocean Weighs Billions of Tons

IF A swimming pool of ordinary size were contaminated with sediment amounting to one billionth of its volume, the effect would hardly be noticeable; but the waters of the deep sea, which suspend this proportion of sediment constantly, contain in all some 234,000,000,000 tons of matter. Professor W. H. Twenhofel, of the University of Wisconsin, has announced these figures as a result of his work in deep-sea oceanography.

This solid matter is contributed to the sea in various forms. The dust fall alone amounts to 260 tons per square mile a year over Europe, and this falls on sea as well as land. Then there are many deposits from organisms such as mollusks, clams, and corals. Material of volcanic origin is also abundant. Professor Twenhofel estimates that the annual deposit of these sediments averages about twenty tons per square mile of ocean basin. And from present estimates of the age of the earth he figures the total deposit of sediment under the seas at 80,000,000 cubic miles.

Measures Flying Fitness by Thyroid Gland

AN AIRPLANE pilot's efficiency depends upon the perfect functioning of his thyroid gland, and not alone on his eyesight, heart condition, and other factors associated with flying fitness. That is the pronouncement of Dr. Leon Asher, of the University of Berne, Switzerland, after experiments with animals.

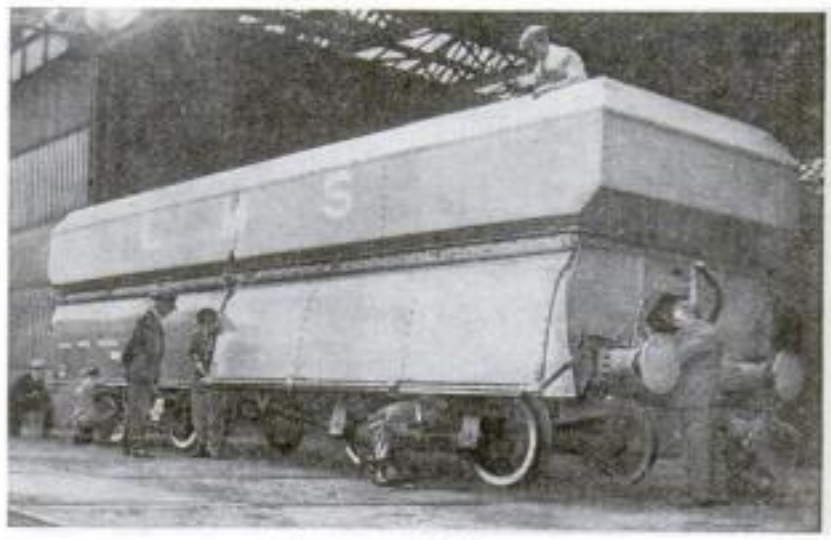
The secretions of the thyroid gland, which in man is near the larynx, play an important part in the constant chemical activity of the body known as "metabolism." Animals with more than the normal thyroid secretion, Dr. Asher finds, require an excessive amount of oxygen, and thus are not able to endure high altitudes. Hence he concludes that a flyer, required to breathe the air of more than ordinary altitudes, needs a perfect-working thyroid gland.

THE names and addresses of manufacturers of devices pictured or described on these pages will be supplied on request whenever possible. Address inquiries to the Information Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y.

New British Freight Car Carries 40 Tons

THIRTY novel coal cars, designed for the largest freight train ever operated on an English railroad, are the latest equipment of the London, Midland and Scottish Railway. Built of steel, they are shaped more like motor trucks than typical freight cars. Each weighs nineteen tons and will carry forty tons, or ten tons more than an average American coal car.

The new car is self-discharging. Covering the lower half of each side are large, hinged doors which, when opened upward by a lever mechanism, permit the load to be emptied quickly. When assembled, the train will be used to transport 1,200-ton loads of coal to a power station supplying the railway's electrified lines.



One of the new truck-type steel freight cars, showing how the hinged door at the side opens upward to discharge a load of coal.

Machine Surpasses Expert in Photo Printing

GUESSWORK is eliminated by a new automatic machine that looks critically through an electric eye at a photographic negative, tells what grade of paper is best suited for making the finished print, and even announces the proper length of exposure to light in the printer. It is expected to improve the prints of amateur photographers.

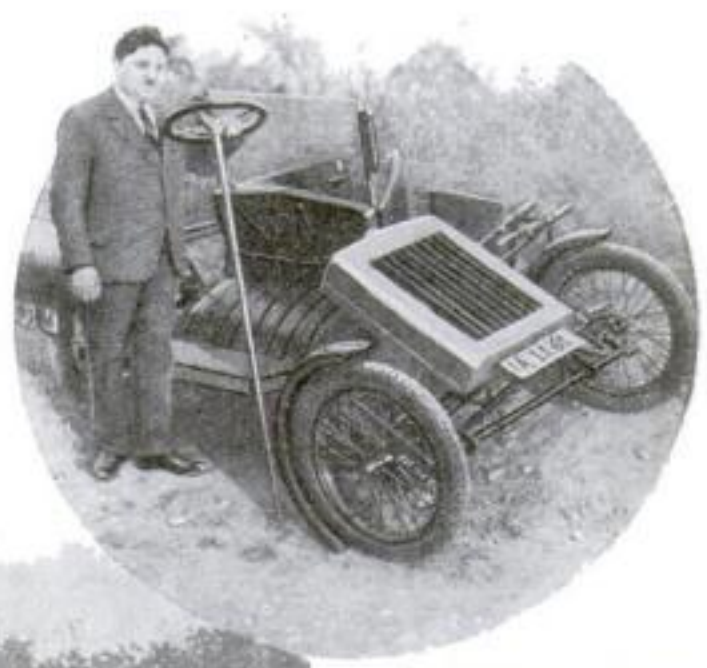
The "printometer," as the new invention is named, was demonstrated recently at Washington, D. C., in competition with an experienced photo printing expert. Its judgment in selecting the right printing paper for each negative, according to the degree of contrast in the high lights and shadows, proved superior to that of the expert.

In appearance the "printometer" resembles a radio set on a small writing desk. On the flat desk surface is a square of glass, through which shines a beam of light to a tube above containing the "electric eye." To operate it, the user slips a negative to be judged on the glass and allows the beam to shine first through its densest and then its most transparent spot. Then he manipulates a dial much like that of an automatic telephone. The negative comes out with nicks stamped on its side indicating the required grade of printing paper and the proper length of exposure to light in printing.

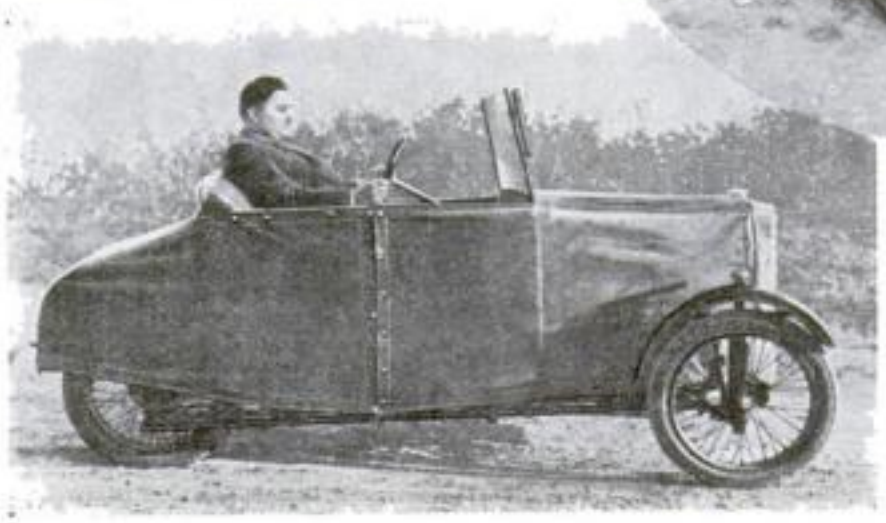
Handy Car—If It Doesn't Fold up on the Road

WITH sides and hood of fabric which can be easily detached, and with a body structure that allows the machine itself to fold up quickly and easily after a few bolts have been removed, a three-wheeled automobile designed in Germany is capable of being stored in a very small space.

In folding the car, after a day's drive, the steering post and wheel are removed, the radiator swings back, the driver's seat is turned sidewise, and the length of the car is shortened by drawing the front wheels and axle backward.



Heinrich Zaschka, inventor of the novel cycle car, demonstrates how it folds up after the fabric body has been removed. He is holding the steering apparatus, which also has been removed.

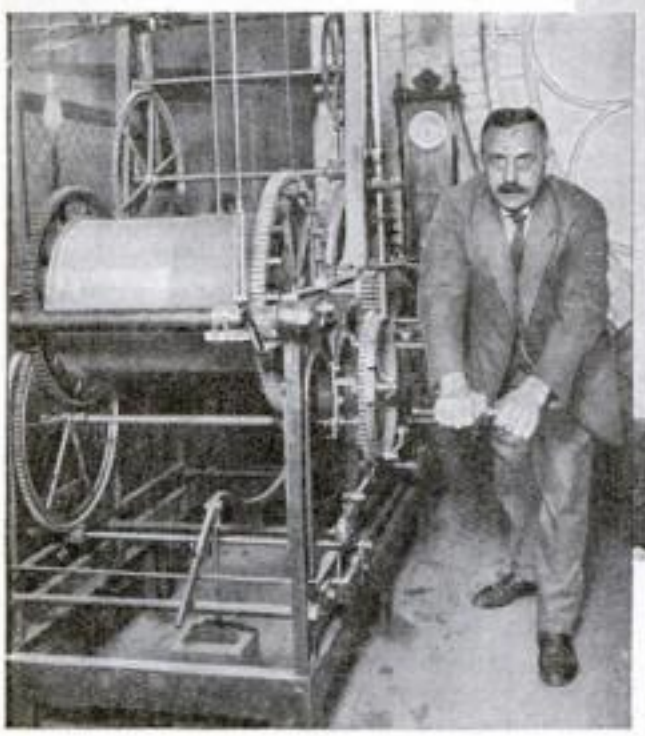


At left: The inventor goes for a drive in his little three-wheeled machine. Note how neatly the fabric body and hood are fitted into a unit.

Berlin Clock Sets 60-Year Nonstop Record

A RUN of sixty years without a stop is the record claimed for the "Big Ben" of Berlin, the giant timepiece in the tower of the City Hall. One reason for the clock's efficiency is that it is inspected and adjusted once a week by its makers, in accordance with an agreement with the city authorities. Only recently the bells that strike the quarter hours were readjusted to clarify their tone.

The intricate mechanism of the huge clock has to be wound once a week by hand, an operation which requires one and one half hours.



The big clock in Berlin's City Hall tower. It has kept running for sixty years without a stop.

Winding the clock by hand, as pictured at the left, is a once-a-week task for a man of patience and a strong back.

Origin of Dollar Sign Is Traced to Mexico

PROBABLY few people, when they make out checks, realize that the history of the dollar sign inscribed thereon has been a source of controversy for decades. The actual word dollar has been traced readily to the German word "thaler," referring to a piece of silver which was in common use in Europe as long ago as the fourteenth century. But the origin of the dollar sign has been more difficult to trace.

According to a recent statement to the American Mathematical Society by Dr. Florian Cajori, Professor of the History of Mathematics at the University of California, the American dollar sign can be traced back to the Mexican symbol for a *peso* or *piastre*. The Mexican sign was a "Ps," the "s" being placed above and to the right of the "P"; but as the sign emerged into broader commercial usage, says Dr. Cajori, an abbreviation was effected resulting in the "s" being lowered upon the "P," thus producing the $.

Prof. Cajori bases his statements upon what he considers authentic West Indian manuscripts dating from 1760 to 1778.

Plays Sweet Music When the Alarm Goes Off

WAKING in the morning to the tune of a dreamy waltz or a stirring jazz selection, instead of to the clamor of an alarm bell, is now made possible by a novel combination alarm clock and phonograph. The outfit resembles a portable phonograph, with a clock set into the case. The phonograph mechanism takes the place of the usual bell alarm. The phonograph is wound, as ordinarily, by a detachable handle and may be set for any hour desired.

It is to be hoped that the widespread use of this device will not destroy the national passion for music.

Setting the phonograph alarm. At the appointed time in the morning the clock mechanism starts the record revolving on its turntable on top of the timepiece.

Chemical Baths Valueless in Preserving Flowers

GIVING cut flowers medicinal baths to prolong their existence is a waste of time, concludes the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., after a survey of the problem. Though flowers are not known to develop headaches, there has been a popular notion that they will be stimulated by baths of aspirin and various other chemicals. Experiments at the Institute showed that potassium permanganate did prevent decay of the stems of phlox and asters, but did not give new life to the floral parts. Some chemicals were found positively to injure the flowers.

Winter weather may help certain flowers, as low temperatures were discovered to be a preserver of roses, carnations, and coreopsis. On the other hand, cold had an ill effect on cosmos and dahlias. Moist air is one great help to keeping flowers. In a saturated atmosphere carnations were preserved two or three times as long as usual.

Father Grows Bald When Babies Are Born

ARRIVAL of an innocent baby may cause the father to lose his hair, Dr. Donald B. Rogers, of Neenah, Wis., has reported to the American Medical Association. He describes a patient who shortly after the birth of his first child lost most of the hair on the left side of his head. Within a year the hair grew in again. Five years later similar baldness followed the birth of a second child. Recently, the hair started to come out a month before the third baby was expected. Curious and pitiless neighbors hope for twins next time.

This so-called "patchy baldness" is sometimes known to follow upon anxiety and nervous distress. Perhaps the ancient savage custom, which ordained that the father and mother both be put to bed as invalids at the time of a childbirth, was justifiable.

Ants Go Insane, Too

ANTS, like men, may go insane, according to the observations of Dr. Robert Staeger of Berlin, Germany. Watching an ant colony, he saw one individual that was doing circular acrobatics, attacking its fellows, and otherwise acting queerly. Isolating the crazy one, Dr. Staeger killed it and sent it to Dr. Rudolf Brun of Zurich, who dissected it under the microscope. A tumor on the left side of the brain was found to be the cause of its abnormal behavior.

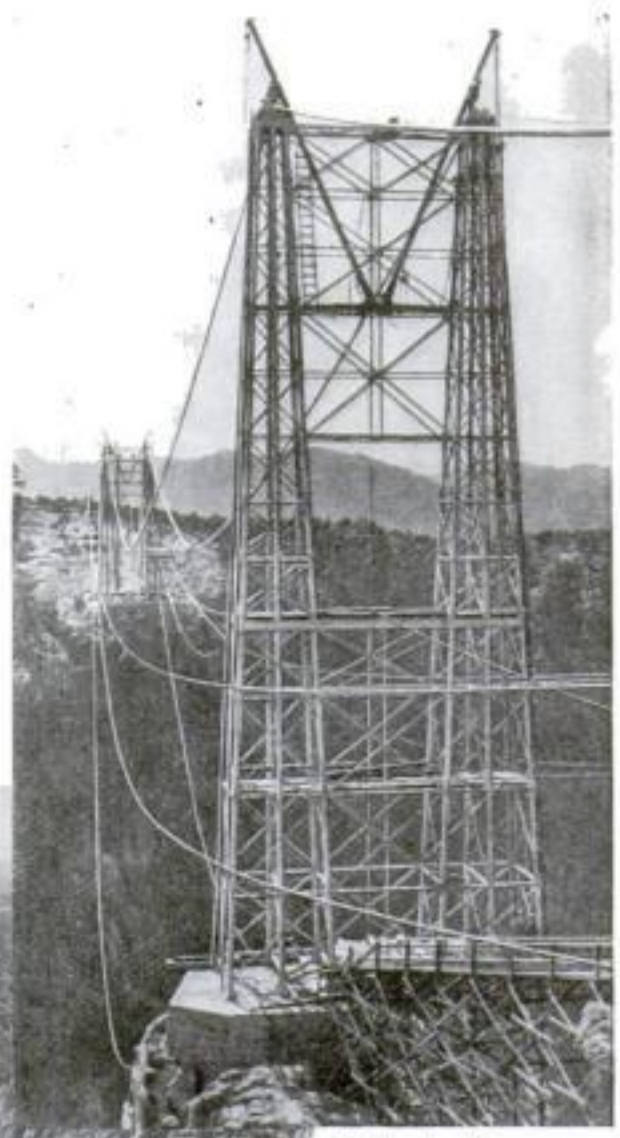
Smoke Bombs Warn Airmen

THREE shells bursting near the plane at ten-second intervals, and producing clouds of black or yellow smoke, mean "Land at once" to a Cuban aviator. The warning is the recently adopted way of notifying him that he is to descend immediately and explain why he has violated one of the local air rules. At night the warning is given by colored rockets.

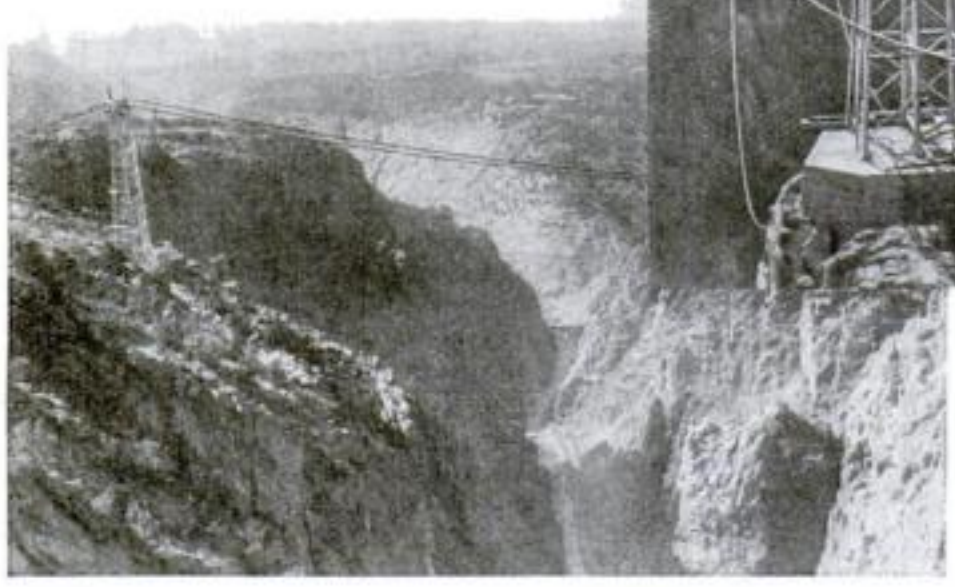
Highest Suspension Bridge Crosses Canyon

HIGH above the waters of the Arkansas River, across the Royal Gorge that in places attains a depth of 2,600 feet, cables are being slung for a suspension bridge which, it is said, will be the highest in the world when completed, near Canon City, Colo. Huge, openwork steel towers sunk into solid concrete masonry on either side of the gorge support the work. The main span of the bridge will be 880 feet long, while the entire bridge, including approaches, will have a total length of 1,200 feet.

The highest bridge in America at present is said to be one over an Idaho river north of Twin Falls. It is 490 feet high, just sixty feet shorter than the Washington Monument (P. S. M., Mar. '28, p. 58). The largest suspension bridge, under construction across the Hudson River at New York, will have a central span of 3,500 feet.



Lofty steel towers embedded in concrete on the canyon rims support the bridge cables.



At the left: Looking down into the Royal Gorge, 2,600 feet deep, across which the bridge is being constructed.

A full grown watermelon in a small-necked five-gallon glass bottle. How did it get there? Looks like the work of a Houdini. But really the trick is very simple, explains Capt. John A. Gilman, of the U. S. Army Quartermaster Corps, at Washington, D. C., who is exhibiting it. The vine which bore the fruit was inserted in the bottle when the melon was about the size of an olive. The melon just grew on the vine and kept growing. And, like many a baffling mystery of magic, that's all there is to it. A trick that any home gardener can try.

Armored Banks on Wheels Call on Depositors

NEW "armored car" banks have been introduced by a Los Angeles, Calif., banking institution to accommodate clients who are unable to get away from work long enough to reach even a neighborhood branch bank. The banks-on-wheels roam through the suburbs of the city continually during banking hours, and the system accounts for a scene becoming more familiar every day there. A tanklike vehicle rolls up in front of a shop; out comes a depositor and does business through a barred window of the car. Small guns point threateningly from adjacent portholes. Armed guards stroll about. Bandits have little chance of engineering a successful holdup.

Ship Travel the Safest

TRAVEL by steamship is far safer than travel by airplane or by train, according to a recent accident report by the United States Bureau of Steamboat Inspection. The report shows that for every 7,000,000 passengers carried by steamship during ten months of 1929, only one life was lost; while one life was lost for every 150,000 passengers carried by rail.

Stomach Shapes as Varied as Fingerprints

IDENTIFYING the stomach by an X-ray fluoroscope may become a future method of criminal detection rivaling that of fingerprinting. In a study of normal stomachs among students of the University of California, Dr. Robert O. Moody and his assistants found four distinct types of the healthy stomach, with numerous gradations in between. Cylindrical stomachs like milk cans, "elbow-shaped" stomachs resembling reversed letter L's, umbrella-handle stomachs like the letter J, and new-moon stomachs like the Turkish scimitar—all were found in varying numbers.

In order to make the outline of the stomach clear to the doctor who is inspecting it, the subject swallows a dose of barium sulphate powder mixed with milk before he goes behind the X-ray screen, barium being a heavy metal opaque to the rays. Dr. Moody says that a greater familiarity with the normal stomach by this method will alter the conception of it which most doctors glean from textbooks of anatomy. Stomachs differ as radically as faces and fingerprints, the doctor claims.

New Grain the Offspring of Rye and Wheat

A FEW months ago a Soviet plant wedding between rye and wheat took place in the laboratories of the Minsk Botanical Observatory in Russia, and the offspring, says the Leningrad *Red Star*, is a hybrid grain of such unusual qualities that it may turn the Russian grain industry inside out.

The infant grain is said to have inherited the good characteristics of both parents, combining the resistance to cold of rye with the richness of wheat. A yield of three tons per hectare (a hectare is equivalent to 2.49 acres) is promised without artificial fertilizer or special preparation of the land. This would be three times the average grain yield in Russia. Already being sown in sufficient quantities to make its possession for general use a possibility next year, this new grain-dynamite may fire an economic revolution in the great Tartar country.

Swarm of Honeybees Ties Up Railway Traffic

DRUNK on honey, a swarm of bees held up traffic on a railway line for nearly twelve hours. Near the town of Karlovac, in Serbia, a switch engine tried to move a freight car and derailed it. A jar of honey was cracked and the honey flowed out on the ground. A few bees buzzing in the region sniffed it and flew over to sample it. In a trice ambassadors were dispatched in a bee line to notify the hoards at home.

A wrecking gang began the work of clearing the crippled freight car off the track. But before they had even warmed up the bee tribe was back at the stamping ground. The air became blacker than a thunderstorm could make it and the wreckers fled in consternation. Not until evening did the bees go reeling home.

Bone Grows from Cells in a Test Tube

THE self-reliance of the individual body cell was demonstrated by recent experiments of Miss Honor B. Fell, working at the Strangeways Laboratories in Cambridge, England. She succeeded in isolating tiny pieces of cartilage gristle from the six-day-old embryo of a fowl and furthering their growth into normal bone in a test tube. Not only did the cells increase to more than three times their original length and take on all the characteristics of live bone tissue, but they also secreted phosphatase, a chemical agent which aids bodily processes.

This ability of a group of cells to develop from cartilage, the normal ancestor of bone in the body, into mature bone, confirms the biologist's conception of the body cell as an organized unit, capable of fulfilling its assigned purpose with remarkable independence if given nourishment. In Miss Fell's experiment, the cells in the test tube were artificially warmed and nourished.

Cancer specialists are particularly interested in such experiments, inasmuch as a cancer cell is merely a cell which has lost its organizing tendency and has gone on a rampage. Hence if the secret of this loss of organization could be fathomed, the cancer problem might be solved.

Moving Rods Test Ability of Bus Drivers

TO TEST the mental agility of bus drivers, the Paris police department now employs the "perceptotaquimeter," an invention of Professor Emilio Mira, of Barcelona, Spain, which measures the ability of a driver to judge the speed of approaching vehicles.

In the examination, the bus driver-to-be is seated fifteen feet away from a table on which is arranged an apparatus consisting of three rods rigged up with pulleys and a rheostat. The rods can be moved at varying speeds in different directions. If the driver can discern quickly and accurately when the rods are to meet, it is assumed that he can make accurate estimates in the larger field of real traffic.

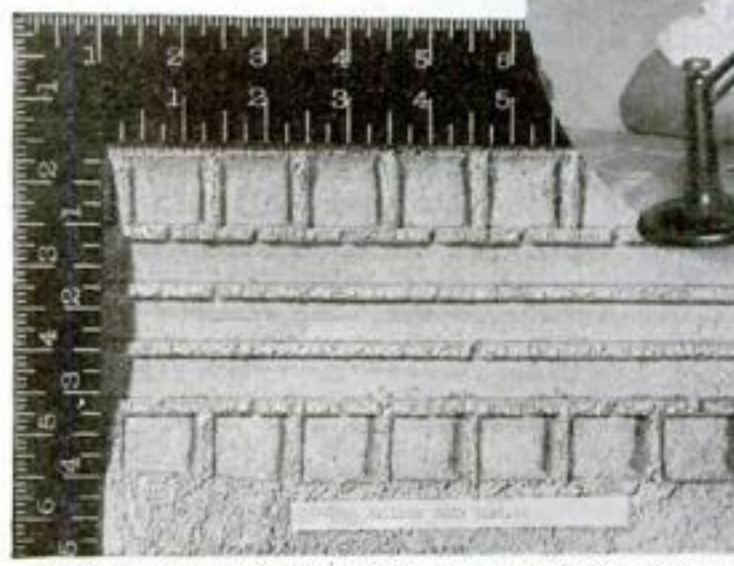
Acid of Hard Cider Now Used in Silk-Making

FROM hard cider to silk is a far cry, but according to Professor D. B. Keyes, of the University of Illinois, the sour acetic acid which changes cider to vinegar will play a major part in a new process for making artificial silk developed by him in collaboration with E. P. King and Sherwood Swann of the same university.

Describing the process to the American Chemical Society, Professor Keyes said that the acetic acid reacts with cellulose to form cellulose acetate, which also goes under the names of "acetate silk" or "lustron," and is the artificial silk itself. But the future source of acetic acid supply is a problem. At present the chief sources are acetylene and wood distillation, but these are inadequate. The Illinois chemists are making progress in a method for boiling it from grain alcohol.

Tire "Fingerprints" to Trace Bandit Cars

SCIENTIFIC identification of bandit cars by the tracks of their tires is facilitated by a new photographic "fingerprinting" method developed by David Chapman, attached to the Sheriff's Office in Los Angeles, Calif. It is based on the simple procedure of placing a try-square beside the imprint of the tire tread on the road when the imprint is photographed.



Photograph of a tire tread imprint, showing how inclusion of the try-square establishes precise measurements.

David Chapman, originator of the new method, comparing a tread "fingerprint" with a tire maker's blueprint.

Experience has shown that identification is difficult by photographs alone, even for experts; for it requires computing the focal length of the camera lens, the height at which the camera was held, and other data before the imprinted pattern can be recognized among some 450 tire patterns in existence.

Comparison of measurements revealed by the new method with tire manufacturers' blueprints and photographs is said not only to establish the size and make of the tire, but to detect the kind of car, its load, its approximate mileage, and whether the car is used mostly in city or country driving.

'Chutes for Army Gliders

PARACHUTES will be a part of the equipment of the United States Army Air Corps' pilotless gliders in the future, according to a recent announcement.

These gliders are towed into the air by airplanes and released. Then they serve as targets for antiaircraft shells. Should the artillery fire miss the costly craft, they are likely to be destroyed by a rough landing. From now on, if they are not demolished by shellfire, parachutes will bring them gently to earth unscathed.

"Fares" Summon Taxis by Street Corner Phones

WAITING in vain on a street corner for a cruising taxi need no longer be the lot of citizens of Rome, Italy, where street telephones have been installed to connect the prospective passenger with the nearest taxi station. Lifting the receiver flashes a signal light in the station.

Two hundred and fifty of these public taxi phones are now in operation in remote parts of the Italian capital.

Calling a taxi by street phone. Lifting the receiver flashes signal in nearest taxi station.

Cosmetics for "Hot Dogs"

"HOT DOGS" with complexion varieties worthy of a beauty parlor's ingenuity were displayed not long ago at a meeting of the American Institute of Meat Packers in Chicago. Dyed in shades ranging from blond to brunette, with countless gradations in between, the flapperish frankfurters showed their seasonal styles like mannikins in a Paris fashion show. According to attendants at the exhibit, there is a "Mason-Dixon" line for frankfurters as genuine as the political one, as the Southerners prefer them highly seasoned and highly colored, differing from the more somber North.

Electric Ocean Liners to Carry 450 Passengers

CONSTRUCTION of two 600-foot electrically driven passenger liners, the first of their kind for transoceanic service, will begin soon in the yards of the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., for the Dollar Steamship Line. They will be sister ships, of twin screw design and built for a speed of twenty knots. Each will accommodate 450 passengers and a crew of more than 300. For general cargo there will be 632,000 cubic feet of storage space, in addition to 67,000 cubic feet of refrigerating space for perishable cargo.

The power plant of each vessel will consist of two steam turbines driving two alternating current generators. These generators will supply electric current to drive two 13,250-horsepower motors, each connected to one of the propeller shafts. Virtually all auxiliary plants of the vessels, such as those for heating and refrigeration, will be electrified.

One of the chief advantages of electric propulsion for ships is the greater flexibility of control. The Dollar line made a two-year investigation with the General Electric Laboratory before deciding to have the ships electrically driven.

Electric Tides Flow High above the Earth

EIGHTY or ninety miles above the ground, three great belts of electric current are continually swirling like tidal floods above the earth, creating the equivalent of millions of horsepower. This conclusion was announced recently by Dr. E. O. Hulburt, of the Naval Research Laboratory in Washington, D. C., a laboratory which has been engaged for several years in studying the electric and magnetic properties of the earth which may affect radio transmission at sea. It was found that there are two daytime currents, one immediately above the other, one flowing eastward and the other westward. At night another current flows continually eastward.

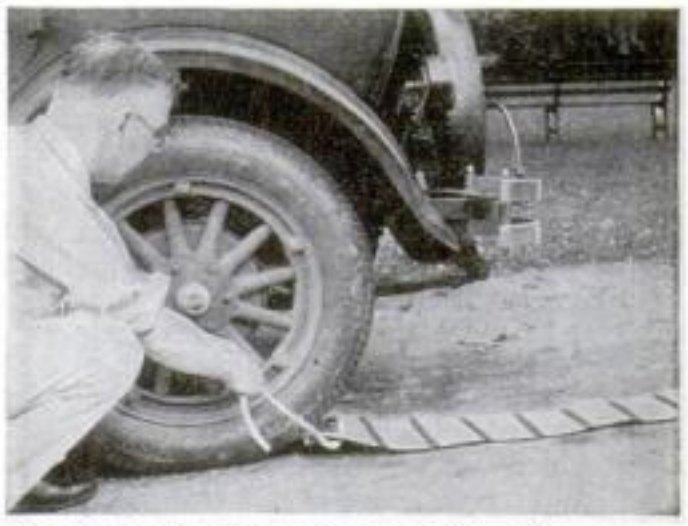
What effects these currents have upon the world at large can only be guessed at present. Experts of the laboratory say that they influence radio transmission at sea, produce variations of magnetic compasses, and alter the world weather. The currents cannot be compared to ordinary wire currents, but are rather like tremendous tides of electrified air atoms. The electrified atoms of neon gas through which flow the light-producing currents in the glass tubes of modern neon signs afford an analogy.

Hunts in China's Wilds

AFTER a year of lonely wandering through the wilds of China, unaccompanied by any other white man, Herbert Stevens, English ornithologist, arrived at Shanghai recently with more than 11,500 specimens which he had collected for the Field Museum of Natural History, Chicago. They included 500 mammals, 1,000 birds, 5,000 butterflies, and 5,000 plants, many of them new species.

Canvas Track Helps Auto Out of the Mire

HEAVY canvas and small bits of rope constitute a device invented by a Chicago woman to extricate an automobile when it is stuck in sand, mud, or snow. This easily portable "tractor" is simply a length of canvas, slightly wider than the tire of a car, with cross-pieces of tar rope stitched at five-inch intervals. It is equipped with fastening ropes at each end. To back a car out of a mire, for example, the ropes at one end are tied around a rear wheel and the canvas laid out as a track. The device folds into a compact package that fits in the tool box.



How track of canvas and rope is fastened to a rear wheel preparatory to backing car out of the mire.

Tarantula Cannibals Grow Meek in the Zoo

One of the cannibal tarantulas from Panama. Fully extended it is about as large as a saucer.

SHIPPED in separate compartments to keep them from devouring one another, fourteen giant cannibalistic tarantulas captured on Ancon Hill, Canal Zone, Panama, arrived recently at their new home in the Reptile House of the Bronx Zoological Park, New York City. These specimens of the venomous insect are unusually large ones. When fully extended, they are about the size of a small saucer.

In their cage at the Zoo, the furry creatures have been devoid of energy; indeed, several of them died within a few days of their arrival. Only in a hot, dark place can they thrive properly. Previous attempts to keep these "ground spiders" at the Zoo have failed. The recent shipment was acquired for a study of the creatures at close range.

The tarantula spins no web, but is able to track down its prey with deadly precision. Crawling slowly but steadily along the ground, it waits until it is within striking distance of its victim and then springs upon it. Its fur-covered legs are so strong that the creature can leap many feet through the air. Its home usually is in a silk-lined burrow, dug deep in dry soil. Under normal conditions it lives for several years.

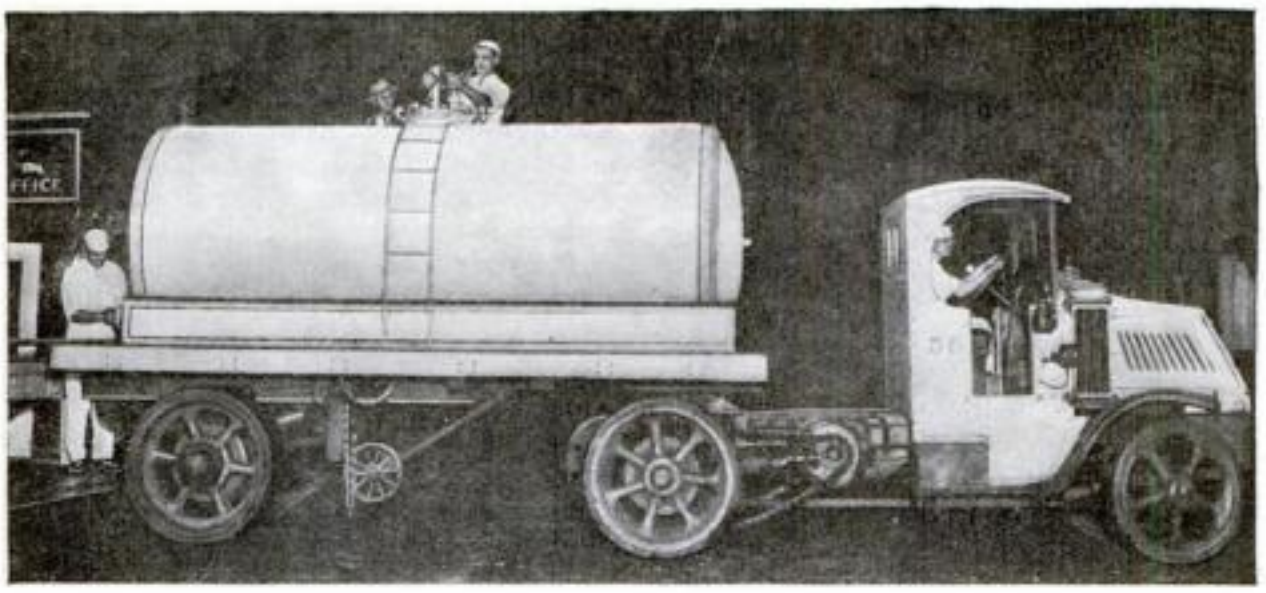
Midget Fire Engine Will Get There First

AN INNOVATION in fire-fighting equipment is a "baby engine," about half the size of the usual fire truck, designed by Sir William Morris, noted British motor car expert. Capable of a speed of fifty miles an hour, its purpose is to dash ahead of the heavier and slower apparatus in response to an alarm. Its small size and light weight make it easy to operate through traffic-congested thoroughfares.

The miniature truck carries two trained firemen—a driver, and his assistant—as well as chemicals, ladders, and life-saving apparatus with which they can go into action before the arrival of the heavier engines. The inventor says that its use will save precious minutes in responding to alarms, and thus will be effective in safeguarding lives and property.

England's speedy new "baby fire engine" carries a crew of two. Here it is compared in size with an ordinary truck.

"Vacuum Bottle" Truck Speeds the Milkman



UNLOADING 8,000 quarts of milk in ten minutes with only one man conducting the operation is the record claimed for a huge "vacuum bottle" milk truck recently introduced in New York City and pictured above. This vehicle is used in transporting the milk from the dairies to the pasteurizing and distributing plant. The speed with which its supply may be handled, it is said, means a great saving of time and labor. The giant vacuum tank also affords protection against undue heating of the milk during fairly long journeys.

Measuring Height of Clouds by Spot Light

WITH the advent of night flying, a special type of electric searchlight known as the "ceiling light" has been employed at airports and landing fields to measure the height of low clouds for the information of pilots flying in darkness. The ceiling light is mounted on a pedestal and trunnion, so that the light can be elevated at any angle desired. Two methods of using it have been introduced. If the light is elevated forty-five degrees the luminous beam forms the hypotenuse of a right-angle triangle, the other two sides of which are equal to each other. The height of the cloud on which the spot of light is seen is therefore equal to the distance from the projector to a point on the ground directly below this spot. The distance can be paced off and thus roughly determined.

An improved method introduced a few months ago by the United States Department of Commerce is to set the projector at an angle of sixty-three degrees twenty-six minutes. At a distance of 500 feet, and

Spot-lighting the clouds with an airport "ceiling light" to measure their height.

in the direction toward which the projector points, is installed an instrument known as an "alidade." This is a large bronze quadrant with a movable arm which can be pointed toward the spot of light, and an arc graduated to show the height of the spot directly in feet. The advantage of this combination of ceiling light and alidade is that it does away with the necessity of measuring distances along the ground and thus saves considerable time.

When the arm of the alidade is aimed at the spot of light, the height of the spot is indicated on the arc.

Coming—Butter, Tires, and Leather from Crude Oil

PETROLEUM, in the future, may supply not only the fuel for automobile engines, but also the rubber for their tires, the material for the raincoats of their passengers, and butter substitutes for picnic sandwiches. Moreover, it may provide soap for use by motorists after a dusty day in the country.

The possibility that these and many other synthetic commodities may be manufactured from by-products of crude oil is predicted by the United States Bureau of Mines on the basis of chemical research now being conducted in a number of laboratories. Aside from artificial rubber, edible fats, and waterproof materials, the Bureau forecasts the development of synthetic leather, drugs, dyestuffs, electrical insulation, cement, and substitutes for varnish and linseed oils.

A wealth of articles, ranging from chewing gum to paving materials, all of them made from by-products of crude oil, already are in general use. Petroleum ether, utilized in laboratories and for priming motors; liquefied gases, used for illumination and metal cutting; alcohols, used in lacquers, soaps, gums, and resins; and gas black, employed in the manufacture of rubber tires, inks, and paints, are chemical products of hydrocarbon gases derived from petroleum.

America's 149,521 Doctors Migrating to Cities

STATISTICALLY speaking, there is only about four fifths of one physician for every 1,000 men, women, and children in the United States. According to a recent Government survey, 149,521 doctors now are practicing among the 118,127,645 of this country's population. As the area of the United States is, roughly, three million square miles, this would mean that there is one doctor for every twenty square miles. Because the vast majority of physicians are established in the large cities, however, these figures are deceiving. The complaint from rural sections that country practitioners are getting scarcer is borne out by the data of the survey, in the course of which it was found that Washington, D. C., for example, has more physicians in proportion to its area and population than any other part of the United States.

Cypress 2,000 Years Old

A CYPRESS tree in Tallahassee, Fla., now grown to enormous height and to a girth of fifteen feet, may well lay claim to an antiquity rivaling that of the famous California redwoods. Professor Herman Kurz, of the Florida State College for Women, asserts that this giant cypress is between 2,000 and 2,800 years old. The tree has survived all sorts of outrages against its life during the ages, but, oddly enough, what threatens it now is not the axe, saw, or devouring beetle, but the ravages of public penknives. Tourists extend their admiration of the tree by inscribing maudlin sentiments on its trunk.

Slices a Thousand Loaves of Bread an Hour

TO DELIVER to customers loaves of bread neatly sliced and ready for the table or for sandwich making, a baker of St. Louis, Mo., has invented a machine which can divide a loaf into twenty-nine even slices with one slash of its blades. Requiring only one operator, it can cut 1,000 loaves in an hour. The bread is loaded on a belt conveyor, and all the operator has to do is press her foot upon a control pedal. The machine does the rest.

The loaves, moving along the conveyor, pass through the slicer, which is a row of upright blades set in a frame much like an oversized egg slicer. There they are cut in quick succession, each emerging with the slices still preserving the form of the original loaf. Before the sliced loaves are ready to be put on sale, each one must be wrapped in wax paper to avoid all possibility of the bread's becoming dry before use. The machine and its conveyor system are electric in operation, being driven by a small motor. This innovation in the selling of bread saves the time of the hostess who has to make up a number of sandwiches for a party or luncheon.

The new electrical bread slicing machine at work in a St. Louis, Mo., bakery. The operator is holding one of the sliced loaves.

Twin Babies Test Value of Child Training

"IDENTICAL" twin baby girls recently served Yale psychologists as subjects in an experiment to determine whether training hastens the development of brain and nervous capacity in very young children. The investigators trained one of the little girls, at the age of forty-six weeks, to climb a set of five steps every day. When she was just a year old, she could perform this feat in twenty-six seconds. Twin number two, without previous practice, imitated the stunt in forty-five seconds at the age of fifty-three weeks. When the babies were fifty-six weeks old, the trained sister climbed the steps in eleven seconds, while the untutored one did it in fourteen.

The psychologists concluded that babies take their own time to develop and that training has little effect upon the maturing process of their faculties.

The Yale experimenters selected identical or true twins, who not only resembled each other physically but who also showed the closest similarity in behavior and reactions.

Hollow Lamp-Posts Remedy for Street Blasts

HOLLOW lamp-posts, to act as "subsoil chimneys," have been suggested by E. J. Silcock, an English engineer who headed a commission which investigated the cause of a mysterious explosion that blew up several city blocks of London pavement some time ago. It had been suggested that bacteria working in the soil had produced the explosive gas. The commission decided that leaks from sewers and mains had resulted in gas collections under the pavement which had been set off by a chance spark. Pipelike lamp-posts, reaching down into the subsoil and allowing the gases to escape, is the remedy suggested.

The soil, which seems so solid, is really like a great sponge, holding water and gases within it. These fluctuate up and down, rising frequently to the surface and passing into the air.

When streets were covered with cobblestones or gravel, gas could escape easily through the cracks or spaces between stones. Within recent years, city streets have been increasingly covered with relatively impervious material—cement or asphalt—and inflammable vapors collecting under such pavement "lids," may result in serious explosions.

This Portable Toilet Kit Includes Running Water

A COMPLETE toilet outfit, including running water, may be carried about as easily as an overnight bag if the portable kit recently shown at a Paris exposition proves as serviceable as is claimed. The equipment consists of a small metal box, divided into two compartments. One holds towel, comb, nailbrush, nailfile, and powder can. Its outer door, fitted with a mirror, is hinged to swing open when the kit is used. The other division holds a tank containing about a quart of water, which is poured into it through a hole in the top. When the equipment is in use, a spigot connected with the tank may be pulled out to project a few inches from the kit and supply water for washing. Opening the inlet hole cover controls the flow.

It Looks Like a Lighter, but Sprays Perfume

SPRAYING a tiny jet of perfume when its plunger is pushed down, a novel atomizer resembling a cigarette lighter in appearance may be carried in a woman's hand bag, it is said, without danger of spilling its contents. Its nozzle is covered with a cap which is released by a plunger. When the apparatus is closed, a groove in the plunger fits over the cap to hold it in place, while the plunger in turn must be pressed down before the cap can move. Thus, its inventors claim, the device is made air-tight and proof against leakage. To operate the atomizer, one need only press the plunger twice—once to release the cap and the second time to eject the spray of perfume. The atomizer is manufactured in two sizes—for carrying in the hand bag and for the dresser.

Resembling a cigarette lighter, this little atomizer sprays a fine jet of perfume when a plunger is pressed.

Smoke Turns Copper Green

THE green coating on copper domes and spires of city buildings can be traced to the action of sulphuric acid in coal smoke, state Dr. W. R. J. Vernon and L. Whitby, of the Chemical Research Laboratory of Teddington, England. The age-film, known as "verdigris" or a "patina," is composed of basic copper sulphate. Samples of copper, some as old as 300 years, were studied by the metallurgists. Telegraph wire which is laid in the sea will show a patina of copper chloride, the chlorine in the sea salt being responsible.

Ruins of Ancient Village Discovered in Arctic

THE frozen ruins of what was once a large Eskimo settlement on St. Lawrence Island in the Bering Sea have lately been explored by two American archeologists, who found there evidence of a culture in the Arctic that may date back a thousand years or more. The ancient village was discovered by Henry B. Collins, Jr., archeologist of the Smithsonian Institution, and Herman Brandt, of Cleveland, O. The island lies between the Seward Peninsula of Alaska and the eastern cape of Siberia. They found bone harpoons, meat picks, and strange objects of carved ivory whose original use is a mystery. Even the Eskimos themselves could not help them solve the puzzle, for no such objects are to be found in the modern Eskimo household. The archeologists inferred that they were once ornaments used in ceremonials.

Three stages of Eskimo culture were unearthed. The most deeply buried objects showed the finest workmanship and probably date back to A.D. 800–900. The topmost layer of objects may have belonged to Eskimos who lived as recently as 300 years ago. The workmanship of these was crude compared with that of earlier ones. Everything points to the theory that centuries ago the shores of northern Alaska or Eastern Siberia were inhabited by an Asiatic race which became adapted to Arctic conditions.

Type of Medium Size Is Read Most Easily

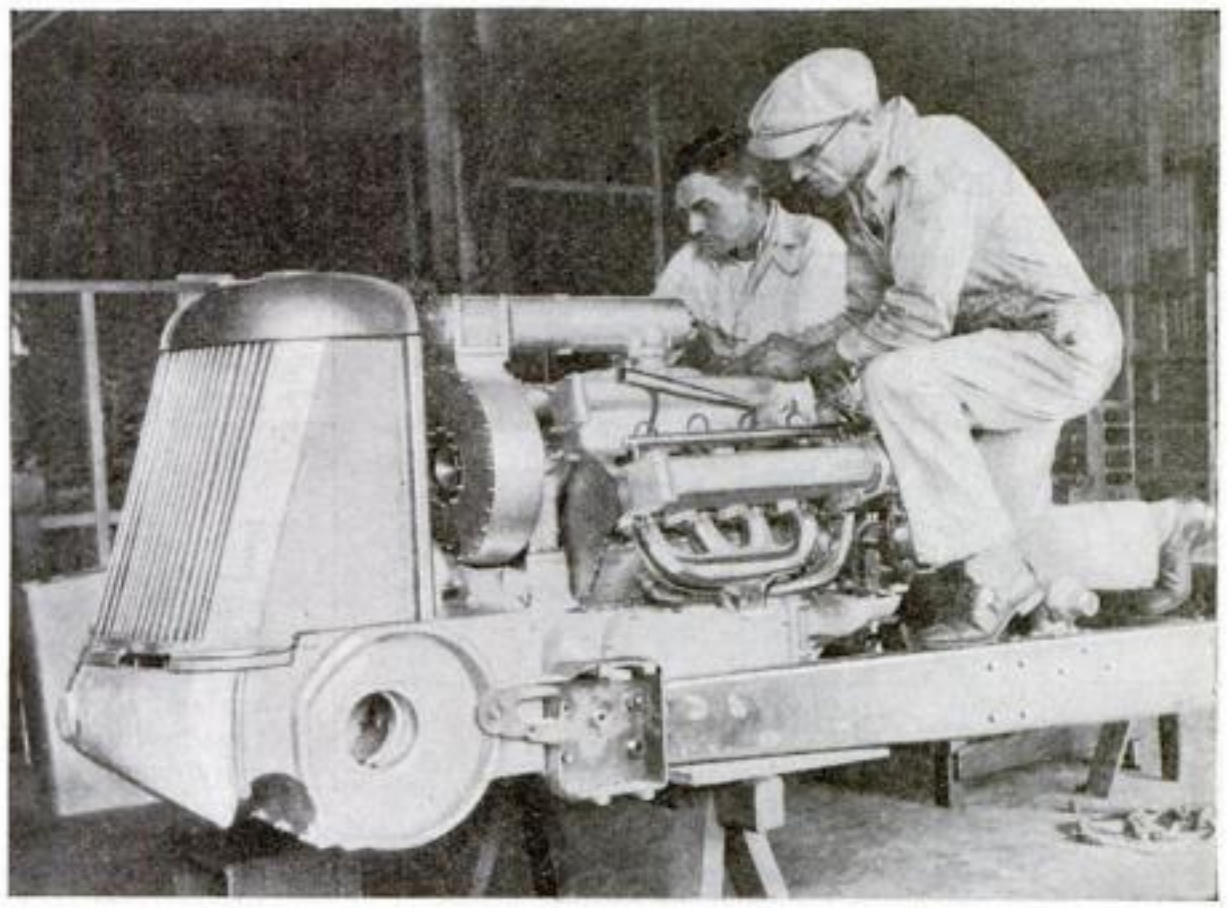
LARGE type cannot be read faster than medium-sized type, according to Professor Donald G. Patterson, of the University of Minnesota. He recently made tests upon 320 sophomores at the University. They were given paragraphs printed in six-point, eight-point, ten-point, twelve-point, and fourteen-point type. The lines were slightly wider than a newspaper column.

The experiment revealed that the paragraphs in ten-point type were read more quickly than those in smaller or larger sizes. The number of words read in a minute with this type was from 5.2 to 6.9 percent greater. Well-printed books and magazines usually use nine- or ten-point type. The type on this page is nine-point.

Sleeping Sickness Enters Mouth of Crocodile

SLEEPING with the mouth open is apparently as bad for crocodiles as it is for mankind. For as the green monster slumbers with its jaws ajar, the dread tsetse fly, carrier of the sleeping sickness microbe, is likely to enter. The disease is not transferred by a bite, but a bite may annoy the crocodile so that it wakes up and snaps at the fly, swallowing it and the germ. Such are conclusions drawn by Cecil A. Hoare from research carried on at Entebbe, British East Africa. The type of sleeping sickness harbored by the crocodile, however, is not identical with the human type, he says.

Front-Wheel Drive for $25,000 Speed Car



Mechanics installing the eight-cylinder, 300-horsepower motor in the new high-speed runabout, with front-wheel drive, built at a cost of $25,000 for the private use of a wealthy New York motorist.

A HIGH-SPEED runabout of an unusual design is being built for the private use of Phillip Chancellor, heir of a wealthy New York family. While it will not attempt to shatter the world's speed record of 231 miles an hour set by Maj. Sir. H. O. D. Segrave, it will be able to amble along at 125 miles an hour, quite fast enough for the requirements of city or interurban travel.

The car was designed by Harry A. Miller, famous racing expert, and will cost $25,000. One of its unusual features is a front-wheel-drive system, which is expected to reduce skidding and side sway and allow for the building of a much lower body by eliminating the need of rear axle housing. The new car will be driven by an eight-cylinder motor that will develop 300-horsepower.

The Latest —A Folding Outboard Motor Boat

A COLLAPSIBLE rowboat, lighter and more portable than a canoe, has been introduced in England. Weighing a bare thirty pounds, it can be folded so easily and compactly that almost any adult can lift it single-handed and pack it away in one side of a garage. It is especially useful for campers and duck hunters, and its light, strong hull of mahogany is especially suited to the installation of an outboard motor.

The new dinghy is ten feet long and two and one half feet wide when folded flat. It is built of three-ply mahogany throughout. When collapsed the sides and stern fold down flat and when open they are kept rigid by the pressure of the seats fitting against them. The boat, it is claimed, may be opened or folded with a single movement. When opened it is nine feet seven inches long by three feet average beam. The price of the outfit, including a small motor, is twenty-five guineas, equivalent to $130 in the United States.

How the collapsible boat is folded for portage. Only ten feet long and weighing but thirty pounds without motor, it can be carried by a woman.

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Speed and Common Sense

RESTRICTIVE law, the popular American panacea for almost any trouble, turns out to be bad medicine with which to cure the automobile speed problem. Neither the motorist nor the pedestrian is benefited by arbitrary and frequently ridiculous limitations on speed.

Speed is only one factor in a complicated problem. Equally important is the question of passing the car ahead. The type of road, the congestion of traffic, the possibility of chicken-headed pedestrians running in front of the car, must also be considered.

A bill recently introduced in the Houses of Parliament will, if passed, abolish throughout England all speed laws applying to private automobiles and will, instead, impose severe penalties for reckless driving. Speed laws already have been eliminated in some States in this country.

Common sense is, at last, being applied to the auto speed problem. The plan proposed by this magazine on another page, we believe, forecasts the ultimate solution.

Wanted—An Automatic Linguist

IN THE days of the silent drama, American-made motion pictures were so popular in foreign countries that the local product went begging. Now comes the talkie. Foreign film producers are gleefully preparing to make bigger and better talkies in their own languages, and now it is the American film that goes begging. Yankee talkies are all Greek to a Frenchman, an Italian, a German, or a Spaniard, and even in English-speaking foreign countries the American accent, if butchered by low grade reproducing apparatus, is almost meaningless.

What's to be done about it? Since no two languages have the same lip motion when expressing the same thought, there seems to be no possible way by which different languages can be recorded on the same film. Taking and recording a picture in each language is out of the question because of the labor and expense involved.

Who can solve this scientific problem and save our export film business?

Science at the South Pole

THE flight over the South Pole by Commander Richard E. Byrd and his companions is more than an exhibition of daring. It is the triumph of thirty years of inventive genius.

The plane they flew, the aerial camera which recorded the character of the wastes below, the instrument which led them to their destination, and the radio which flashed the story of their triumph with the speed of light to a waiting world are all products of recent years. Peary's arrival at the North Pole was followed by five months of silence while he was making his way to civilization and a telegraph line. In Commander Byrd's expedition, even before the plane landed at the Antarctic base, American newspapers were streaming from the presses announcing the success of the flight.

An estimate of the scientific value of this aerial dash over the high south polar plateau awaits study of the photographic film and other records of the trip. Immediately apparent, however, is its value as a spectacular demonstration of the advances of science since the turn of the century.

Shunning the Roof Tops

ELSEWHERE in this issue Assen Jordanoff, war bird, air mail pilot, and aviation instructor of sixteen years' flying experience explains why he refuses, under any circumstance, to risk the peril of flying over a crowded city. Over the countryside he will tail-spin, loop, or perform any other circus stunt without a qualm; but at risking a crash on city streets or roof tops he draws the line. That his fears are justified was tragically demonstrated in the recent crash and death of an experienced pilot on a building at Columbus Circle in the heart of New York City.

On another page of this issue is pictured a scale model of a $10,500,000 air terminal building with a roof-top landing field nearly 1,000 feet long, projected for the city of Los Angeles, California. Presumably airplanes will be required to dip close over the city to land.

These circumstances do not jibe. If one of the world's most experienced pilots finds over-city flying more hazardous than the tightest tail spin, how can cities safely operate roof-top airports?

Here is a dilemma that requires a definite answer before Los Angeles or any other city attempts to hurry aviation.

Running Away from a Bullet

SOME years ago Walter Johnson, probably the fastest pitcher baseball has ever seen, consented to a chronographic test of his speed. He pitched a baseball that whistled over the testing range at a velocity of 130 feet a second.

To the observers, the ball seemed to travel at tremendous speed, but if A. H. Orlebar, British flying ace, who recently established a new airplane speed record, had been traveling by in his airplane at the same instant, he would have outdistanced that speeding baseball literally as though it were standing still. Orlebar has streaked through the air at the rate of about 540 feet a second!

If someone had fired a .45 automatic pistol at Orlebar's back as he whizzed by, the bullet would have hit him with a velocity considerably less than 260 feet a second—probably insufficient to penetrate his heavy leather jacket.

And if the pistol shooter had happened to be a bit slow on the trigger, giving Orlebar a start of only a hundred yards, the bullet never would have caught up to him at all!

They Are Saying—

"NO 'SCIENTIFIC bad boy' ever will be able to blow up the world by releasing atomic energy."—Dr. Robert A. Millikan, President, California Institute of Technology.

"'Daily dozen' exercises foster a dislike for physical activity in the minds of children."—Dr. J. F. Williams, Professor of Physical Education, Columbia University.

"In twenty or thirty years, a 100-story building in New York City will be looked upon as antiquated and its removal will be required."—Harvey Wiley Corbett, New York architect and designer of skyscrapers.

"The man of today who lives a year is living the equivalent of five years in activity, travel, and association as compared to the man of a century ago."—Attorney General Fred H. Davis, of Florida.

"The majority of divorces could be avoided if lovers, before marrying, took the trouble to study the psychology of themselves and their future partners."—Dr. John F. W. Meagher, Brooklyn, N. Y., neurologist.

A business executive using an audiophone, one of the newest aids for the deafened.

New Help for the Hard of Hearing

The author of this article is Professor of Otology in Cornell University Medical School. He tells how science may rescue millions from the borderland of deafness.

By GEORGE B. McAULIFFE, M. D.

OF THE hundred million and more persons in this country yearly subjected to the general noise of life, one out of every six has defective hearing. The fact is so startling as to merit restatement. Although there are only 55,000 deaf mutes in the United States, more than twenty million men, women, and children suffer from deafness in some degree. Of this great number, many thousands may be quite unaware of their affliction. In a family of mother, father, and four children it is more than likely that at least one is handicapped by hearing things vaguely. Most important of all, some three million school children are daily straining to hear what is going on in the classroom, and are blighted in their attempts by various hearing defects. These are some of the revelations of a recent study of Government statistics, extensive tests by public schools and clinics, and the reports of social workers and countless ear specialists.

Can anything be done to help the millions stranded on the borderland between good hearing and deafness? I say "borderland" because the great majority of the deafened reside just there, hearing what everyone else hears, but exerting tremendous effort to make sense out of it. Few people know that even for the extremely deaf the hurly-burly of noise is not totally cut off, but reaches them as a confused murmur from which pleasure and value are stripped away because of their inability to distinguish the jumbled sounds that batter their ears. The blind are pitied, but their loss of vital touch with the outer world is in many ways far less tragic mentally than that of the deaf. The blind at least are exempt from the ugliness of appearances, and may build up, within, a world of imagery fairer than the one without. But the totally deaf may see, and are denied the means by which to interpret in conversation the thing seen.

THE crux of the problem lies here: Seventy-four percent of the deafness existing today could have been cured if it had been caught during childhood. Most deafness is acquired, and like many other acquired things it can often be cast off. Acquired deafness is generally the result of ear neglect. It may follow one of that dread trio of childhood diseases—scarlet fever, measles, and meningitis. Other diseases that may lead to it are diphtheria, influenza, whooping cough, syphilis, and lung tuberculosis. The presence of inflamed adenoids may engender a catarrh of the ear resulting in deafness. Ear disorders have other causes than these, however, and that leads to a consideration of the varieties of deafness and how radically they differ.

EAR troubles vary according to the part of the ear affected. The two principal types are "middle ear" deafness and "nerve" deafness. In the middle ear is the delicate mechanism of hearing. The outer ear acts merely as a sort of megaphone to collect the sounds which vibrate through space and to throw them toward the eardrum, besides protecting the drum membrane from irritants and changes of temperature by means of its hairs, wax, and length. Neatly tucked away within the middle ear are three tiny bones, called ossicles, one shaped like a hammer, another like an anvil, and a third like a stirrup. These are so locked together as to form a lever system like one of the type levers of a typewriter. The handle of the little hammer bone, lying in the eardrum, receives its vibrations, which are transmitted by the lever action to the stirrup bone; this in turn plays against a membrane over an "oval window" that connects with the inner ear.

The impulse of sound moves the handle of the hammer about one thirtieth of an inch. This movement becomes in the anvil about one one hundred and eightieth of an inch and by the time it reaches the stirrup has become one three hundred and twentieth of an inch—a movement equal to about the length of a microscopic blood cell. By this leverage system the thrust of the sound impulse has been increased thirty times. The minuteness and delicacy of the mechanism may be appreciated from the fact that the hammer weighs only one third of a grain, or about one thirteen hundredth of an ounce, and that the stirrup has a play of one one hundredth of an inch in the oval window.

IN THE inner ear are lodged the end fibers of the nerve which carries sound impulses to the brain. The inner ear is a small bony box which incloses two parts more intricate than the labyrinth of mythology. One part is composed of three semicircular bony tubes, each one at right angles to the others; the other part looks like a snail's shell. These are connected by a vestibule. The cavity of the snail's shell is divided by a membrane whose 24,000 fibers are thought to analyze sound received by the terminals of the cochlea or hearing nerve. The pretzel-like scheme of winding canals (which, incidentally, is responsible for the sense of balance) and the snail spiral contain a watery fluid that acts as a medium for the vibrations which buzz the nerve of hearing and also give warning of a change of balance.

When the middle ear becomes inflamed from infection carried up the eustachian tube—the air tube which connects the ear with the throat—a serum is discharged in the cavity of the middle ear and mastoid. This may pass out through the eustachian tube or may collect in sufficient amount to cause earache and break through the drum membrane, or it may form bands or adhesions and hamper the delicate movements of the drum or ossicles. If the

Testing the hearing of school children with an audiometer. Equipped with headphones, it produces a scale of musical notes of decreasing intensity.

"Talkies" enjoyed by the hard of hearing, using theater phones.

inflammation is severe, pus will form, break through the membrane, and result in a discharging ear, eventually destroying one or more of the ossicles.

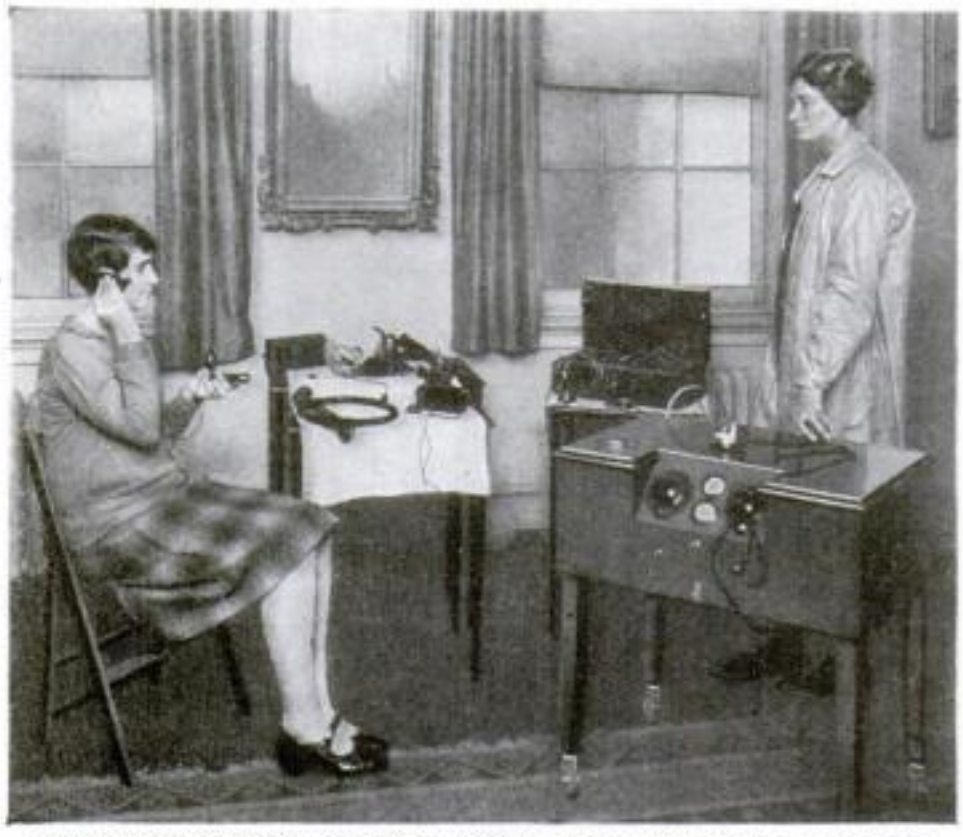
The inflammation may pass on into the mastoid bone, be pent up there, and destroy the cells, resulting in that much feared disease—mastoiditis. It may even continue upward to the brain, or backward to the great vein of the brain—the lateral sinus—and thus give rise to infection of the blood stream or the neighboring brain tissue. Not only the diseases already mentioned, but colds and like ailments that allow entrance of infected matter up the eustachian tube may also give rise to these ear troubles. It is for this reason that I have suggested that babies be taught to sleep on their stomachs, since the position of lying on the back permits almost a direct flow from the nose and throat to the middle ear. Likewise persons with inflammation of the ear should rest with the head high. Adults having middle ear deafness should not work under conditions where nose or throat is liable to infection.

IT IS easy to imagine, then, the probable state of the ear if conditions following infections are allowed to go scot free. Hence the importance of undergoing a systematic examination of the ear and hearing acuteness, and care following any one of the diseases which may cause ear trouble; above all, the pursuit of proper treatment in case trouble arises. And so I come to the conclusion that the problem lies with the care of the child, for after childhood the evil effects of an ear infection are usually too deeply rooted to warrant a return to normal hearing.

The other cardinal type of deafness is "nerve" deafness. This is a more subtle type, and harder to define. In some instances there may have been inflammation of the nerve of hearing itself in the brain. Or there may have been an inflammation of the labyrinth to which the nerve is attached, so that impulses never reach the nerve centers. Scarlet fever, measles, influenza, or whooping cough again may lead to such an inflammation. Or perhaps the patient may have suffered from childhood a lack of development of brain centers or a disordered nervous system which prevents the adequate working of the ear mechanism as a whole. For such cases treatment is given to the mind alone, and is a matter of infinite care and insight.

Recently there has been much publicity about remarkable cures resulting from airplane rides. What actually has been cured in these cases is not a real deafness, but a form of "shell shock" peculiar to certain hysterical children. A sudden dip in an airplane may all at once release the "complex" which is binding the child's mentality. It is always wise, however, to consult a qualified specialist before expecting benefits from such experiments. In the presence of disease of the ear, this method of treatment is futile.

Right here I want to make clear one or two points about "deaf" people that everyone should know. Years ago all persons with impaired hearing were called deaf. Those who had been born without hearing, and consequently did not know how to talk, were called "deaf and dumb." Today scientists realize that there is a world of difference between being born deaf and growing hard of hearing in later years. The former are now known as "the deaf" and the latter as "the deafened" or the "hard of hearing," according to the degree of impairment. A person who is only hard of hearing will resent being called deaf just as much as anyone who wears glasses would resent being called blind. Of all the really deaf people about one third have been afflicted since birth. Of this group thirteen percent were children of cousins who married in spite of constant warnings. More than forty percent of those deaf from birth inherited their malady, but for nearly half the cases no cause can be found other than Nature's whim.



Hearing aids, including electric amplifiers and membranes to replace eardrums, demonstrated at the New York League for the Hard of Hearing, Inc.

IN AN early issue: An article telling of the new discoveries about sleep—what it is, how to woo it, and how to get the most out of it.

BUT some one may ask, "How can anyone, especially a child, know whether his hearing is faulty?" For parents, there are many danger signals for the detection of bad hearing in children. Inattention, dubious articulation, a weary or exhausted expression before the day is half over are all suggestive. Once taken to an ear specialist or a clinic, the child may be examined in various ways. The "audiometer" is the modern instrument for testing hearing. Resembling a miniature radio set, the instrument produces a scale of eight notes, each of which can be decreased in volume until the listener no longer hears any sound. This latter point indicates the patient's "threshold of audibility," which varies widely with good and bad hearing.

Of greater import is the testing of children in schools. In many cities the public health authorities are installing apparatus for this purpose. Considering that an audiometer with eight receivers costs little more than $200, there is no reason why every public school should not be equipped with one, as it can test dozens of children a day. Many schools are now "ear-testing" large groups of children by phonograph records. A record providing a series of numbers read with diminishing intensity is relayed to several children at once through a group of receivers. The children check on paper the numbers they are able to hear. Although not as accurate as the audiometer, this method of testing enables the examiner to catch evidence of impaired hearing, so that if necessary the more technical test can follow.

PREVENTION of deafness among children assumes a new importance in the face of the economic problem which the modern world presents to deafened adults. Ten years from now three million "hard of hearing" school children will be seeking a means of livelihood. Granted that the handicapped deaf will have received instruction in lip reading and have been guided into vocations suited to their handicap, will it be possible to absorb them all into occupational life? In many ways the modern world, with its accent on efficiency and speed, is cruel (Continued on page 141)

Modernizing the Old Radio Set

Most Any Out-of-Date Receiver Can Be Improved in Volume and Tone Quality by a New Speaker and Audio Amplifier Equipment

By ALFRED P. LANE

A modern power amplifier system added in a cabinet beneath an old-type battery set. The new unit is connected to the detector tube in the receiver.

WHAT shall I do about the old radio set?

That question has almost as many answers as there are types of out-of-date receivers. To find the correct one in any particular case, a number of factors must be considered. First is the age and present condition of the receiving equipment. Next comes the kind of service the outfit has been giving—stations received, tone quality, troubles experienced, and so on. And after that the cost of any proposed changes. In the end the cost is the controlling factor. If expense need not be considered, the answer is simple. Throw the old set in the scrap pile and buy the finest modern outfit obtainable. Not everyone, however, can solve the problem so easily.

There probably are thousands of receivers in use that were bought in the early days of radio broadcasting and still look and work as well as they did when new. Among these are many battery sets fitted with 201A tubes throughout and some form of horn or early cone type speaker. What to do with such an outfit depends on what the owner wants in the way of reception that he cannot get with his present equipment. If he wants more distance and greater selectivity in addition to more volume with better tone quality, the case is almost hopeless. The necessary improvements on the old set would practically require building it all over again. The best solution is to be satisfied with the present equipment until a new electric set can be purchased.

OF COURSE, it is simple enough to change the wiring so that a power tube, type 171A, can be used in the last audio stage. This will improve the tone quality and volume handling ability. However, the type 171A tube will increase the current drawn from the B battery, making the set more expensive to operate. Adding the power tube will not be an improvement unless the loudspeaker equipment also is brought up to date. Many of the old horn type speakers give such poor tone quality that it is not worth while to use them with a power tube.

A large group of receivers that still give good results are battery operated but fitted with power tubes. Here, too, the advisability of attempting to improve the distance getting ability and selectivity is questionable. To do so requires practically complete rebuilding.

The first all-electric sets form another large group. Some of these are reasonably good; others are not, either because of poor design or some freak system of operation. Rebuilding such sets to give them better distance getting ability and more selectivity is, as with old battery sets, an almost impossible accomplishment.

By far the largest group of sets now in use are the full-electric outfits that were built subsequent to the first experimental electric sets. In most cases these sets do not compare with the latest models for distance, selectivity, tone quality, or volume.

ASIDE from the use of a good external wave trap circuit there is no effective way to improve the selectivity of any old set without virtually rebuilding it. The tubes now available, such as the A. C. type screen grid tube, are capable of far more sensitive operation than earlier types of tubes, but it is not practical to use these new tubes in any old set. The advantages of the tube are not obtained unless the entire circuit is designed to take advantage of their possibilities.

If, however, the owner of an out-of-date receiver is satisfied with the distance and selectivity features of his receiver, no matter what its age, there are many ways by which the tone quality and volume handling ability can be improved and even made equal to the capabilities of any modern receiver. As already mentioned, a power tube can be fitted in the last stage if the set hasn't one, and rebuilding the entire audio amplifier circuit is in many cases relatively easy. New and better transformers can be fitted and even a push-pull circuit installed (P. S. M., Nov. '29, p. 71).

It also is possible and extremely practical to build or buy a complete new audio amplifier unit which can be connected to the detector tube in the set in place of the audio amplifier circuit already installed. The question of whether to do this rather than to wait and purchase a complete new outfit depends largely upon the quality of the set in question. If, for instance, it was originally a cheap set in a cheap cabinet the improvement is not worth while. But if the old receiver was in its day a fine outfit in a well built console or other type cabinet, the net result of fitting a new audio amplifier system and a new loudspeaker will be to give the owner equipment that for tone and volume on the local and semidistant stations will equal or surpass any modern set. The expense will be less than the purchase price of a modern set capable of the same tone quality and volume.

The most satisfactory results for the money spent will be obtained from an amplifier circuit that includes a push-pull stage using the 245 tubes. An amplifier to handle 171A tubes will be less expensive but far less powerful, while one using the 250 tubes will be more powerful than necessary and the cost nearly double.

TONE quality and volume depend both on the audio amplifier circuit and on the loudspeaker. It is, therefore, poor economy to add a new audio amplifying system without also adding a new loudspeaker, and this should preferably be of the modern, dynamic cone type.

Kits of parts or completely wired amplifiers can be obtained with or without the necessary circuit to supply B voltage to the set. If the receiver is of the battery operated type, obviously it is an advantage to obtain the B supply from the power amplifier circuit and thus eliminate the use of B batteries.

A new power amplifier usually can be substituted in an old set merely by cutting away the two leads to the primary circuit of the first audio transformer in the set and connecting them instead to the input terminals of the power amplifier unit.

Useful Hints for the Radio Fan

Spotting Dynamic Speaker Ills

Where to Look for Troubles That Cause Queer Noises or Fading Volume—How to Test Electric Sets for Hum

IN MANY ways the dynamic cone speaker is an extremely rugged mechanism. The field magnetism, since it is produced by the flow of an electric current, never weakens so long as the current flow is maintained.

The dynamic speaker has definitely improved tone quality. But its wide frequency range of tone coupled with the method of construction sometimes accentuate faults that would be unimportant in a less efficient unit. On the very low notes, for instance, it may actually have a motion of as much as a quarter of an inch—many times the possible motion of even the best magnetic speaker. This imposes a severe strain on the diaphragm and on the mechanism holding it in place.

The illustration on this page shows where trouble can occur and where to look if ever the speaker begins to produce queer, rattling noises or scraping sounds, or the volume falls off appreciably.

When the dynamic speaker is not in use the diaphragm is under no strain. The front edge is maintained in a central position by a thin, soft leather ring, the outer edge of which is clamped or otherwise fastened to the metal frame, the inner edge being cemented to the paper cone.

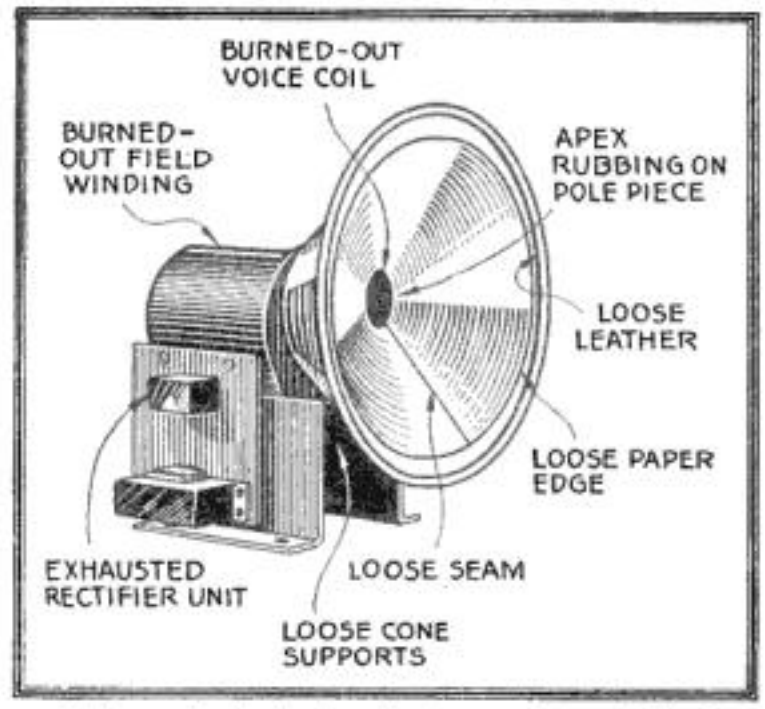
The cement is not infallible. When subjected to a severe strain, such as a crash of static, it may break loose at some point. If this occurs on the edge of the paper diaphragm the loose edge of the paper will vibrate against the leather and produce a rattling sound that usually will be most pronounced on one particular tone frequency.

The leather itself may become loose at its outer edge and produce a similar but less evident noise.

Many dynamic cones are made from a single piece of paper with one cemented seam running from the apex to the edge of the cone. Occasionally this seam gives trouble. The cement gives way at some point and the loose edges of the paper rattle together.

Looseness also may develop in the cone support arms.

Muffled and distorted music and speech, if it is not due to some defect in the set itself, often is caused by the ring at the apex of the cone rubbing on the pole piece. The clearance at this point is very small, in some cases not over five thousandths of an inch. Testing for this trouble is easy. Take a piece of writing paper and see if it can be slipped in the crack between the pole piece and the center ring of the cone. If so move it all the way around the circle without binding at any point. If it can be so moved the cone is not in trouble at this point.



If the speaker begins to make strange noises or falls off in volume, the trouble may be at one of these points.

Extremely weak reproduction on A. C. type dynamic units may be due to an exhausted rectifier unit.

A burned-out voice coil or field winding would put the speaker out of commission at once, but such troubles are so rare that they need not be considered.

Reviving B Batteries

MANY B batteries produce grating and scratching noises some time before they are actually exhausted. Such noises can be eliminated and the useful life of the battery extended by connecting across the block a two-microfarad filter condenser of the type ordinarily sold for use in building a B eliminator and power amplifier circuit. If two condensers are available connect one across the entire B voltage and the other across the detector B voltage.

Testing for Hum

THE critical point in any full electric receiver—the point where hum is most likely to be produced—is the detector circuit. Consequently whenever an A. C. receiver begins to develop a steady hum the detector tube should be investigated. In many types of circuits, when the set is first turned on, a hum immediately develops and then dies out as the detector tube heats to operating temperature. As the tube becomes older the time required for it to reach operating temperature becomes longer and longer, and in many cases the hum does not die out. It is a good idea, therefore, to have a good, new spare detector tube on hand. Then when the set develops a hum, substituting the spare tube will give a definite indication as to whether the detector tube is to blame. If the hum continues with the spare detector tube in place some other part of the circuit is at fault.

In any electric set the hum is not always of the same intensity. Some nights it seems to be worse than others. This variation frequently is caused by changes in the line voltage or in line operating conditions.

The hum is much less when the phonograph pick-up is used. This is because the pick-up does not produce hum, and when it is cut into the circuit detector tube hum is eliminated.

A B C's of Radio

TO DETERMINE the cost of current to operate an electric set, first shut off every house light. Then, watching the electric meter, turn on the radio set and count the number of turns the disk in the meter makes in one minute.

Shut off the set and, by experiment, find the number of lamps which must be turned on at once to make the meter disk rotate at the same rate. Divide the figure 1,000 by the total wattage of these lamps, then divide the resulting figure into the cost of current per kilowatt hour. The result will be the cost of operating the radio receiving outfit in cents per hour.

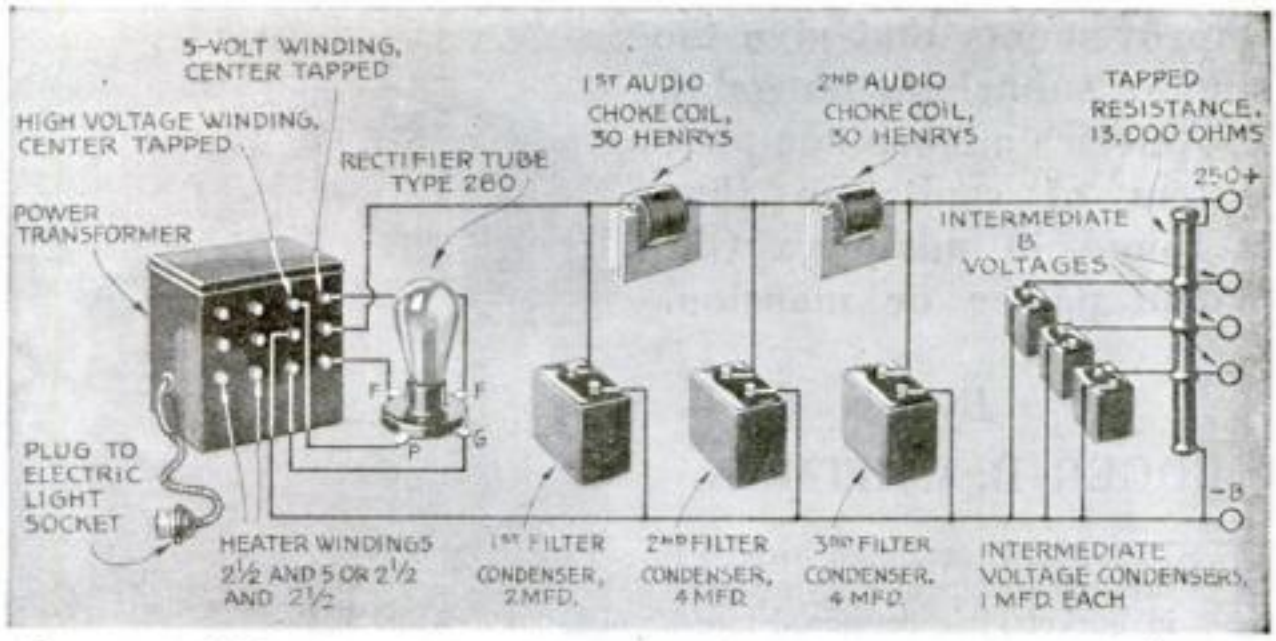
For example, assume that the current costs ten cents per kilowatt hour and that a fifty-watt light bulb equals the radio set. Fifty goes into 1,000 twenty times. Dividing ten cents by twenty gives one half cent an hour as the cost of operating the set.

Current Filters for A. C. Sets

How Receivers Draw B Voltage Supplies from Light Sockets

By

JOHN CARR



Arrangement of choke coils and high capacity condensers in a typical filter circuit. Pulsating current from the power transformer is converted by this circuit into pure direct current for the receiver.

ALL radio receivers, however designated, actually operate on direct current. Though alternating current flows into a modern electric set from the light socket, direct current still does the work in the radio receiving circuits just as it did in the days before light socket operation was possible. Even the alternating current tubes use alternating current only in the heater circuit. Direct current is absolutely necessary in the plate circuit.

Packed away in some corner of every electric receiver is a group of parts in a circuit whose function is to convert the pulsating alternating current into direct current. Alternating electric light current flows through one part of this circuit and direct current is drawn from it.

Radio broadcast signals received by way of the antenna are essentially alternating or pulsating in character. To amplify and transform these signals they must be impressed on the direct current flowing in various parts of the circuit. If raw alternating current were flowing in the plate circuits of the various tubes, the radio signals impressed on them would result in a hopeless jumble and a roaring sound from the loudspeaker. Trying to impress radio signals on a current already broken up into the oscillations of raw alternating current is like attempting to write legibly on corrugated paper.

There is no metallic connection between the wire leading to the electric light socket and the other circuits in the receiver. In fact, the electric light current flows only through one coil in the power transformer. The currents that actually operate the receiver are all magnetically induced in the power transformer.

THE power transformer, in most electric sets, has a primary winding and four separate secondary windings. Electric light current flows through the primary winding and alternating voltages are produced in the four secondary windings. One of these gives five volts and is applied to the filament of the rectifier tube. The high tension winding has so many turns of fine wire that it develops upwards of 600 volts, or more than 300 volts on each side of the center tap. The remaining two secondary windings are either two and one half volts apiece, if the set uses 224, 227, and 245 tubes; or two and one half volts and five volts respectively if the set uses 171A tubes in the last or power stage.

The rectifier tube has a filament and two plates. The ends of the high tension winding are connected to the two plates, and the center tap on the five-volt winding that heats the rectifier filament becomes the positive terminal of the rectifier output circuit. The center tap on the high tension winding is the negative terminal. The output is direct current in pulsating form. This pulsating current is fed through the filter circuit, the component parts of which determine the quality of pure direct current which will be sent through the circuits of the receiver. The filter circuit is made up of iron core choke coils and high capacity condensers arranged as shown in the diagram.

IN THE usual circuit where three condensers and two choke coils are used, the first condenser largely determines the voltage which will be produced. If the capacity of the condenser is increased the output voltage is increased. The condenser connected between the two chokes has the greatest effect in the filtering action, so that increasing this condenser produces smoother direct current and less hum. The third condenser also has some influence on the smoothness of the direct current, but its chief function is to form a reservoir from which the power tubes may draw instantaneously heavy supplies of current to form the oscillations that make up the radio-frequency and voice-frequency impulses.

One secret of the great power of the modern electric set, as compared with older battery types, is in the rectifier circuit. A power transformer can be constructed to develop any desired output voltage. Starting with 110 volts from the electric light line, it is possible to develop the high voltages necessary to operate modern power tubes at full rated capacity. To operate such tubes from dry cell B batteries would require at least six heavy duty forty-five-volt blocks, and their life would be measured in weeks.

The output of the filter circuit is high voltage direct current practically free from pulsation, and this high voltage is applied directly to the plates of the power tube. Other tubes in the receiver, however, require lower voltage direct current, and these lower voltages are obtained by taps on a resistance connected between the high voltage lead and the minus B lead. Each one of these taps must be by-passed with a fixed condenser to form a reservoir from which the tubes operating at lower voltages may draw their supply.

There are no moving parts in the entire circuit and there is, consequently, no wear mechanically. If properly constructed, the power transformer should last a lifetime, and that applies also to the filter chokes. Modern receivers of the better grades are fitted with condensers which should have an operating life of at least ten years, figuring that the set is in use three hours a day during that time.

The rectifier tube, the type 280 which is most commonly used at present, has a normal operating life of 1,000 hours—the same as the radio tubes in the set.

Even in the most perfectly constructed rectifier and filter circuits trouble may occur. After the receiver has been in use for many months a falling off in volume may be noticed, together with some distortion. The trouble may be due to tubes in the radio receiving circuit, or to an exhausted rectifier tube. The remedy, of course, is to put in a new tube.

ANY sudden and severe increase in the hum from the loudspeaker may be due to an exhausted tube in the radio receiving circuit, or to a short-circuited choke coil. This is a rare occurrence. If by chance the lead wire to one of the filter condensers becomes disconnected there also will be a severe increase in hum.

The rectifier and filter circuits of all modern receivers do not exactly correspond with the diagram on this page. Some large and powerful sets, for instance, use two rectifier tubes of the half-wave variety instead of a single full-wave rectifier tube, and in other sets one of the filter condensers and one of the filter chokes is dispensed with. This often is the case in receivers designed to use power detection with only one audio amplifier stage. The filter requirements of such a circuit are less rigid.

A Revolution in House Plumbing

Improvements that give the simple suburban bungalow in America a more complete system of sanitation than is found in many an Old World palace or mansion.

By

ROGER B. WHITMAN

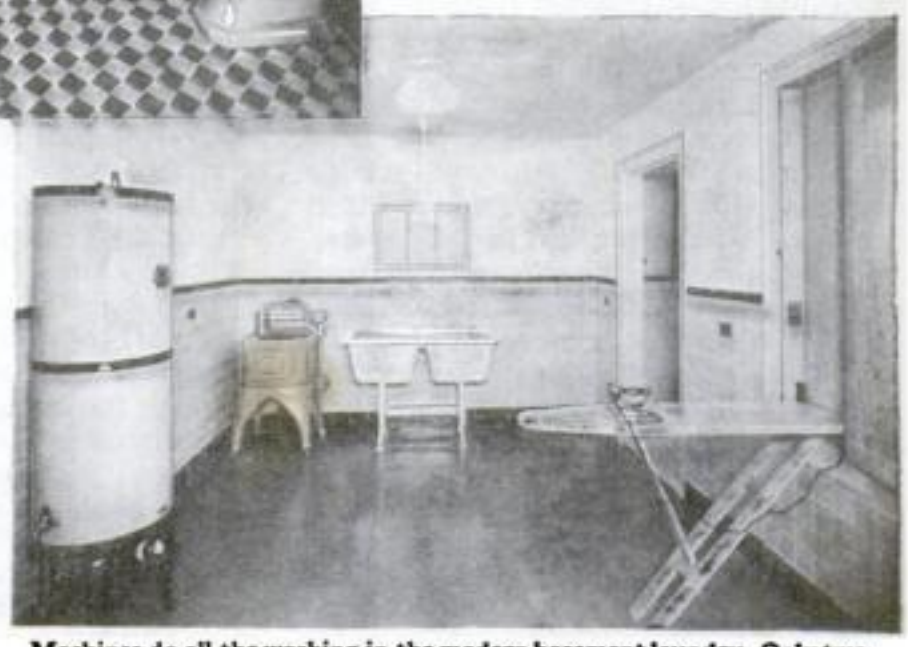
PLUMBING, first used because it saved the labor of carrying water in buckets, has developed into a national household safeguard of health, as well as an indispensable household convenience. Some dwellings now are equipped with a bathroom for every bedroom and one or two more for general use, while in virtually every modern home are kitchen and laundry fixtures designed for labor-saving and water supply and waste outlets placed where they will be most serviceable. Fixtures and other exposed parts of a plumbing system have been given beauty as well as utility, fixtures now being available in color.

The old type bathtub, the bane of existence for a housewife because of the difficulty of cleaning beneath and behind it, has been replaced by the built-in tub that becomes part of the walls and floor. Sometimes it is set in a recess with but one side exposed. Bathrooms thus can be made extremely small without impairing their usefulness, which answers the present-day need for compactness, offsetting the high costs of labor and material. It is possible to have a complete bathroom in a space five feet square. Advantage of this is being taken in alteration work. The end of a hall or the corner of a room can be walled off, two closets thrown together, and odd spaces cleverly utilized. A closet two by six feet in size will hold a shower stall and toilet, a wash basin being hung on the other side of one of the walls. With such arrangements possible, there no longer need be a shortage of bathrooms.

The first need for a plumbing system is a water supply under sufficient pressure to drive it through the pipes and out of open faucets. When there is a community water system, the source is usually a high reservoir with gravity pressure. For isolated houses the tank may be in the attic or on a tower or hill, but a better plan is to use compressed air. For this there is available a tight metal tank with two openings at the bottom, one connected to a pump and the other to a pipe leading to the faucets. The air within the tank is compressed as the water is forced in, thus supplying continuous pressure. Another plan is to connect the supply pipes directly to a pump.

The colorful modern bathroom conserves space. Note how the bathtub is recessed into wall at rear.

Courtesy F. P. Platt & Bro., Architects



Machines do all the washing in the modern basement laundry. Only two tubs are necessary. At the left is an electrically heated water tank.

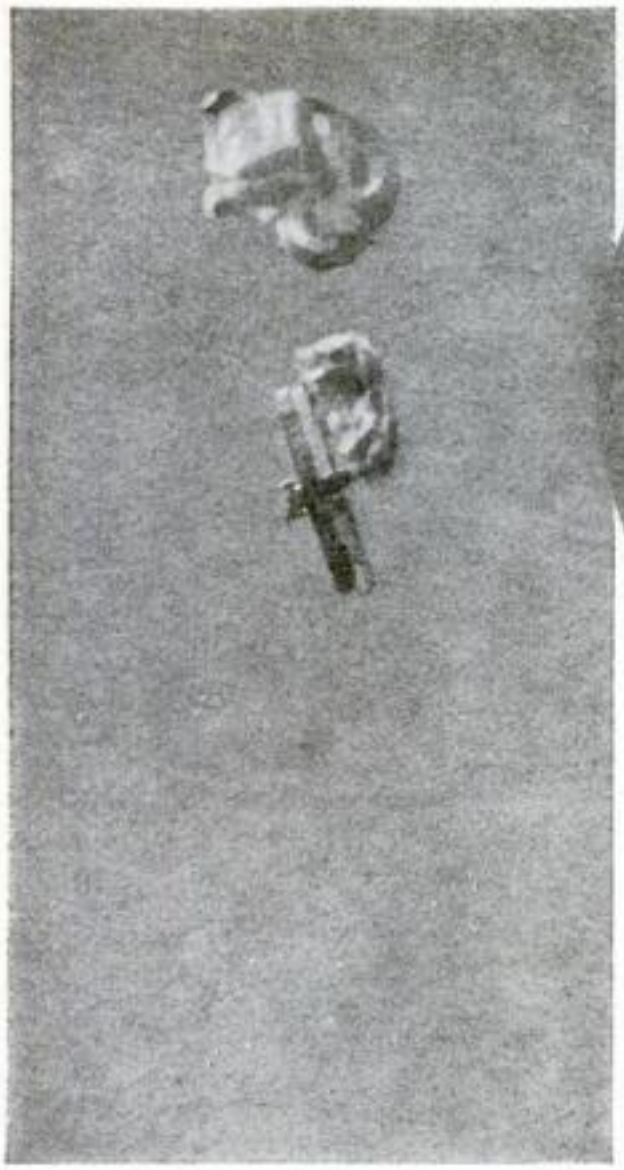
Being under pressure, the supply pipes of a plumbing system must be strong enough to resist it. Moreover, they must not be affected by the water that flows through them, for rusting will lead to leaks and to clogging of the pipes. With pure water, pipes made of galvanized iron or steel will give long service. In most cases, however, impurities have such an injurious effect on iron pipes that brass is in increasing demand.

Plumbing systems sometimes are so poorly installed or so clogged that when water is drawn from one faucet it will not run elsewhere in the house. To avoid this the supply pipe should be large enough to supply several outlets at once. Under moderate pressure, from forty to seventy pounds, the pipe connecting a bath, kitchen sink, or laundry tub to the supply pipe should be three fourths inch, while one half inch will be right for a lavatory, toilet, or shower. The size of a supply pipe will depend on the number of faucets and other outlets that it feeds. Since the pipe connecting the house with the street main must supply not only the fixtures, but often water for such other needs as sprinkling the garden or washing the car, it must be of ample size. It must be flexible, for stiff pipes and connections may break from the heaving of the ground as it freezes or thaws, or from the vibrations of heavy street traffic. Lead pipe usually is used for this purpose, although it is being displaced in some instances by pipes of soft copper.

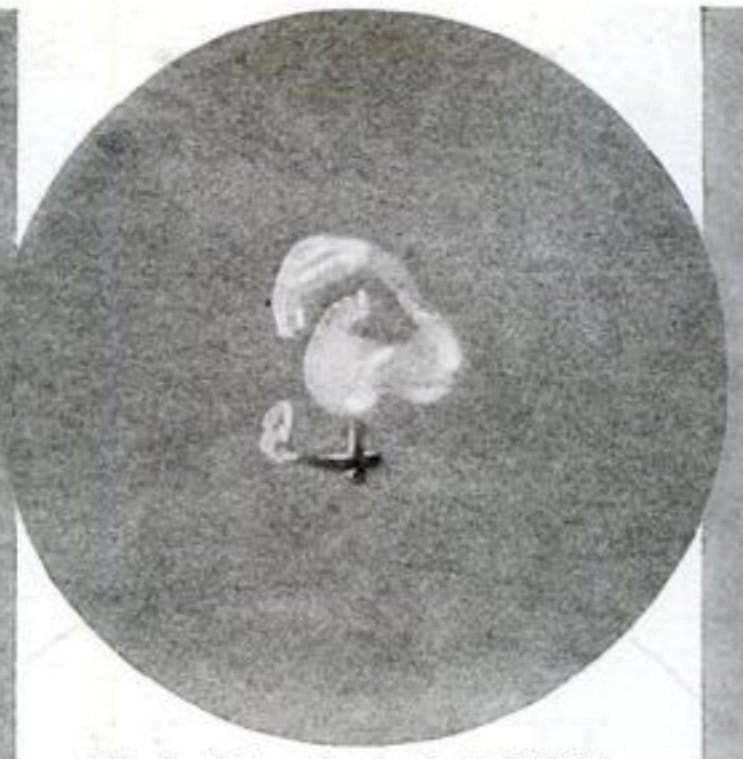
Soft copper tubing which can be readily bent around corners is the latest thing in water supply piping.

An improved method of piping that eliminates most of present tedious processes of cutting, threading, and fitting greatly simplifies the laying of the water lines. The pipe used is copper, and instead of being in stiff, short lengths is in sixty-foot coils. Connections are made with compression couplings like those used on an automobile gasoline line; the squarely cut end of the tubing is funneled with a special tool and compressed between a nipple and a collar.

This type of flexible tubing is installed by drawing it through walls and under floors to the various outlets, for while it resists flattening and kinking, it is soft enough to bend around corners almost as easily as the flexible conduit used in electric wiring. At each outlet the pipe is cut and a tee clamped on, a job that takes only a few minutes. This tubing is especially useful in replacement work and in modernizing, (Continued on page 143)



Entangled in the opened parachute, the ship plunges down in a flat spin for 3,700 feet with the helpless pilot trapped in cockpit.



Releasing the two wing parachutes 5,200 feet up. One 'chute is opening while the other remains closed, throwing plane into a spin.

Novel Wing Parachutes Fail Plane

The pilot's escape. His small chute has opened 500 feet above the ground, and the plunging plane, pursuing, is dangerously near.

THE extraordinary photographs on this page were taken during a recent test of a new system of huge parachutes designed to support an airplane in the sky—an experiment from which the pilot of the plane, M. J. McKeon, of San Mateo, Calif., barely escaped with his life.

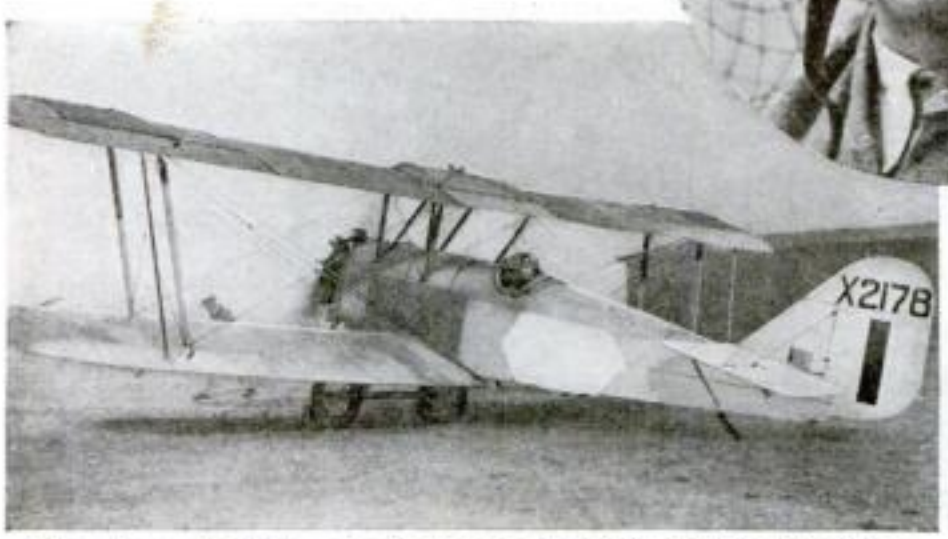
The theory of the invention, designed by Charles Broadwick, of San Francisco, was that a pilot lost in a fog could release two parachutes (one strapped to the underside of each upper wing of the plane), let the plane drift downward until he could get his bearings, cut away the 'chutes, and resume flight. It was assumed that the plan of twin parachutes would have the effect of keeping the plane in perfect balance during the descent.

McKeon climbed 5,200 feet and released the big 'chutes by means of wires leading to the cockpit, while twenty-five aviation experts watched from below. The parachute on the left wing opened slowly, but the one on the right remained closed. The plane, thus unbalanced, was thrown into a flat spin and immediately wound itself in the opened parachute as though making a shroud for itself; and McKeon was trapped in the cockpit.

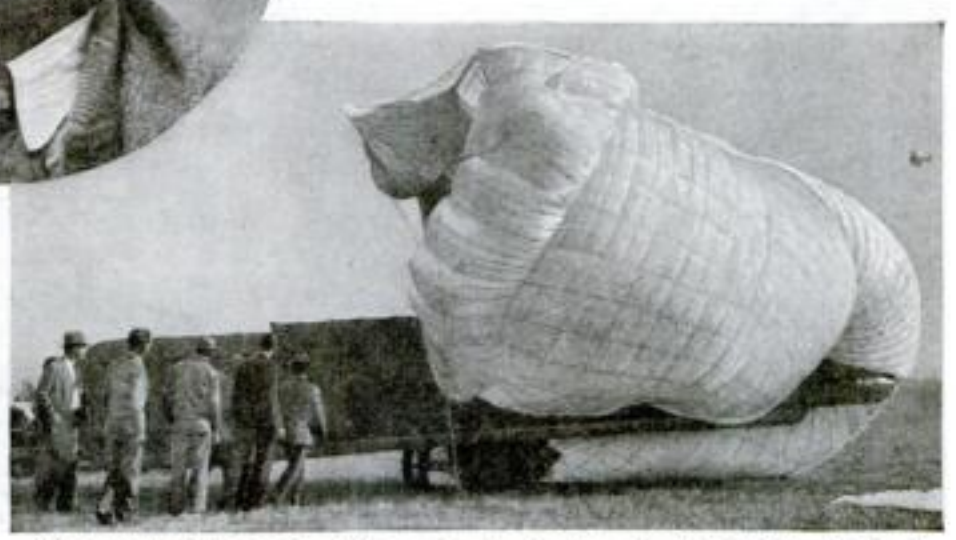
The plane was dropping steadily while he fought desperately to escape. When it was only 1,500 feet from the ground he emerged from under the folds and crawled onto a wing. A sudden spin broke his hold and he slid down the wing, catching frantically at a strut. The next instant he had thrown himself clear of the plane and was dropping down. The falling plane pursued him closely. He tugged at the ring of his own parachute. It did not open. Another 1,000 feet down—only 500 feet above ground—and his 'chute finally did open.

Still the plane chased McKeon, threatening at any minute to cut through his own 'chute and dash him to destruction. By tugging at the shrouds of his parachute he managed at last to steer it out of the path of the plane. Immediately after he touched the earth, the plane crashed less than 100 feet away and was badly wrecked.

The entire episode was graphically recorded by a plane which accompanied McKeon in his mile-high climb, and from which a photographer snapped pictures of the various stages of the near-tragedy from the moment that the treacherous right parachute failed to open.



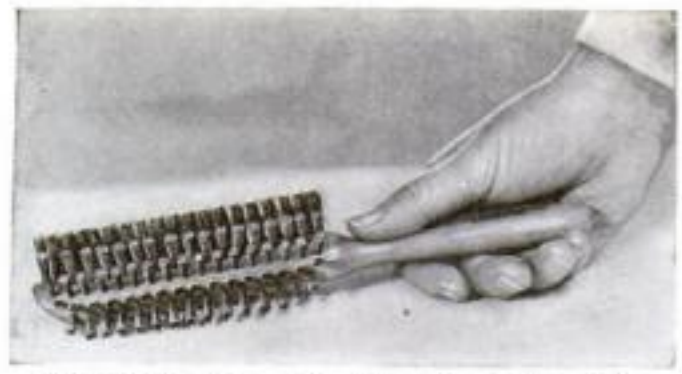
Warming up the biplane for the test in which Pilot "Mickey" McKeon (in circle) barely escaped with his life. The 'chutes are on the upper wings.



The wrecked plane after the crash, showing how hopelessly the ship had become entangled in the big parachute, designed to support it in the air.

Household Inventions

Cracked ice for drinks may be kept without melting in this vacuum ice crock, designed like a vacuum food bottle. Handy tongs hang on a bracket at the side.



At the twist of the wrist, either short or long bristles are available with this novel hairbrush. The bristles, arranged in rows about the base of the brush, are graduated in size. Thus, the turning of the brush brings rows of different lengths into use.

A pair of tongs with toothed jaws to hold a fish, and a special scraper for scaling it, comprise a new outfit which simplifies an otherwise tedious task.

A compact electric water heater, small enough to fit in a pocket. Water circulating through perforations in the aluminum shell is rapidly warmed.

A simple invention for keeping food fresh is an "ice shelf" consisting of a metal tray that rests directly on the block of ice in the refrigerator. Food is thoroughly chilled by close contact with the ice. As ice melts, the tray moves downward-

Latest of bottle openers is a pencil with reenforced notched top that lifts off any standard cap. The pencil can be carried in a pocket, the maker says, without danger that the opener will tear the clothes.

When bacon is grilled on this new electric table stove, the clear drippings drain off to the cup below. Meat or fish may be cooked on the device, and pancakes served hot at the breakfast table.

Useful pads for saving table tops from marring by dishes are made from discarded auto inner tubes. Attractive designs can be made by placing a wavy-edged dish on a tube, marking the outline with a pencil, and cutting on this line.

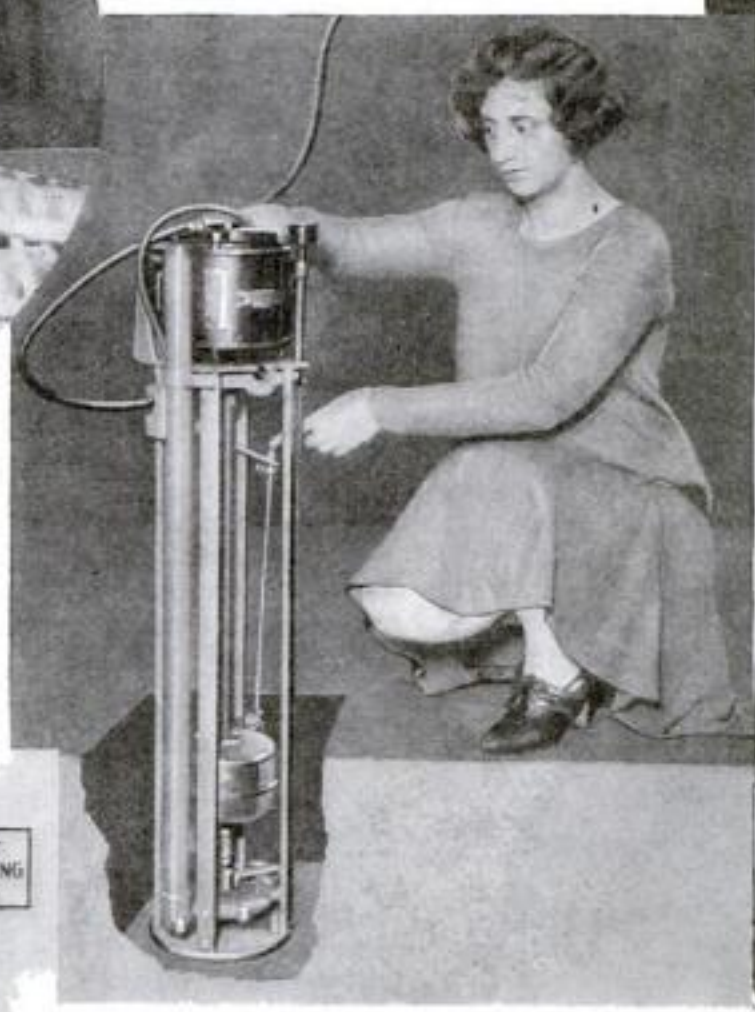
The tongs at the right are designed to handle hot eggs, vegetables, and biscuits. Squeezing the handle makes the tongs grip the harder. Ingeniously hinged joints provide desired leverage.

These double-thickness bags keep vegetables fresh in iceless refrigerators. An inner porous bag retains the necessary moisture, to which the outer chemically treated bag is impervious.

This new knife and scissors sharpener is screwed to a convenient corner of a table. A few strokes in one of its two V-shaped slots puts an edge on the blade.

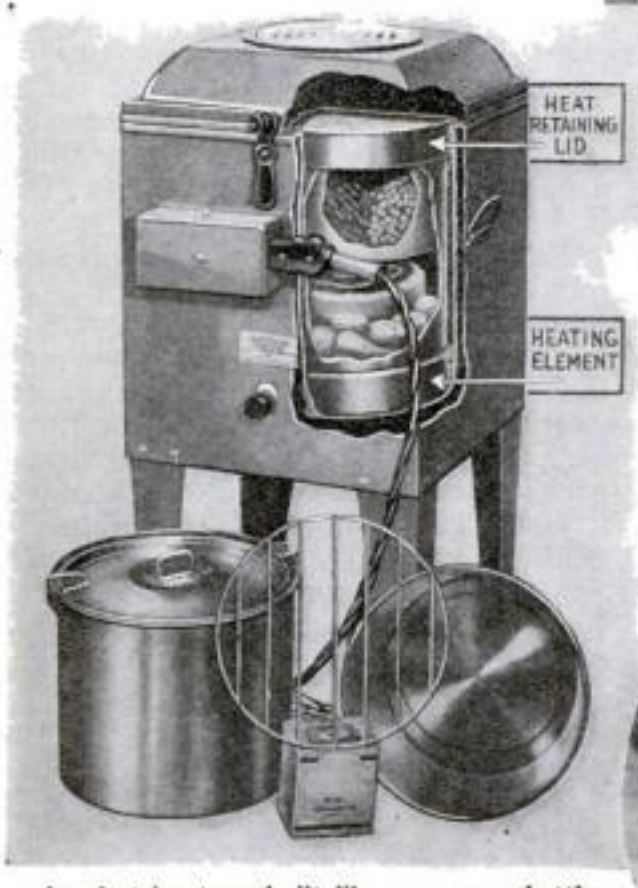
The need of space-saving utensils for the small stove is met by this group of pots and kettles recently exhibited in London. The elongated shape of the kettle in the center requires less room than the round form and the pots fit snugly against it.

"Sandwich waffles," a new idea in cookery, are turned out four at once by this waffle iron. Each waffle comes out with a lengthwise depression in the center, to be filled with a "hot dog," creamed chicken, ice cream, a salad, or other sandwich delicacy.

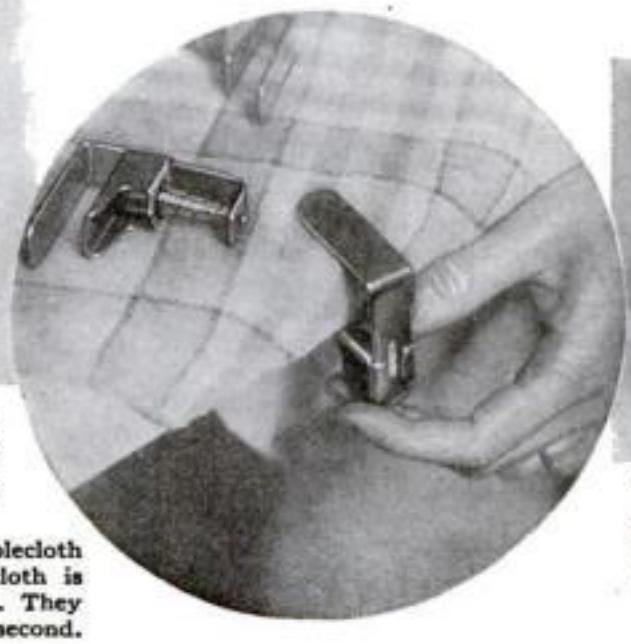


House cellars subject to occasional floods may be kept dry by this electric pump installed in a well in the lowest corner of the floor. Rising water lifts a float which, making an electrical contact, starts the pump working. A hose discharges the water through a cellar window.

The combination of spoon and fork in these scissor-handled tongs provides a useful tool in the kitchen for lifting hot foods from the pot. The tongs are also handy for serving.



An electric stove built like a vacuum bottle. It uses up electricity for only a few minutes; then the current shuts off automatically and cooking is continued with the retained heat.



The baby can't pull off the tablecloth and wreck the dishes if the cloth is held by these spring clamps. They can be attached easily in a second.

This wire hook with a long-reach handle makes it easy to fish hot pans from the back of the oven without burning the hands. The hook reaches around a bean pot, as shown, or captures an elusive potato.

What Horsepower Really Is

Gus Explains How Auto Designers Get More Pull Out of the Engine Cylinders by "Continuous Levers"

By

MARTIN BUNN

"ONE hundred horsepower!" Joe Clark whistled to himself as he read the specifications of one of the new cars.

Gus Wilson, veteran auto mechanic and Joe's partner in the operation of the Model Garage, merely grunted. His mouth was too full of ham sandwich for articulate expression.

"One hundred horsepower!" Joe repeated. "That's a whale of a lot of power to be controlled by a dinky little pedal under the toe of your shoe. It's equal to fifty pairs of horses. Think of an auto able to pull as strong as that many horses!"

"Why think of it when it isn't so?" Gus growled as he fished a vacuum bottle from his lunch kit. "Fifty pairs of horses could drag any auto ever made all over the lot."

"But I thought you told me gasoline engine horsepower was the same as real horsepower," Joe protested.

"I did," admitted Gus. "A one-horsepower gasoline motor, if you applied its power just right, could lift 33,000 pounds one foot every minute all day long. It'd take a pretty husky 'oat motor' to equal that."

"Then," Joe mused, instinctively reaching for a pencil, "a hundred-horsepower motor ought to be able to pull 3,300,000 pounds. Gosh! That's more pull than a big politician has."

"That's right," Gus smiled. "Figures don't lie, but sometimes they don't mean anything, either. You could get that much pull out of a one-horsepower motor just as easy if you geared it right. Trouble with you and a lot of other folks is you don't know what horsepower really means."

"YOU said a one-horse engine could lift 33,000 pounds," Joe argued. "If that's the bunk, then just what is a horsepower anyway?"

"You forgot I said it could lift that much weight a foot in a minute," replied Gus. "How long it takes and how far the weight is lifted are just as important as the weight itself. That's what horsepower is—a sort of combination measure of the work done and the time it takes to do it. It doesn't make any difference whether you lift 33,000 pounds one foot in a minute or twice that weight half the distance in the same time. It still needs one horsepower to do the job. But if you tried to yank the 33,000-pound weight up two feet in a minute you'd need two horsepower. Or if you could take two minutes to move it up a foot you'd get by with only half a horsepower."

"Now I'm beginning to understand," said Joe. "The pull or weight-lifting power isn't a measure of horsepower at all."

"Not if you take it just by itself," Gus explained. "A long time ago there was a bird named Archimedes who got a lot of notoriety by claiming he could move the world if somebody'd give him a long enough lever and a place to stand. Nobody could call the old duck's bluff and he knew it, but he had the right dope just the same. If you could go sailing out into space with a nice long lever, hook the end of it under the earth, and rest it against any other planet that happened to be handy, and you had some way to get a toe-hold on the ether that's supposed to fill space, you could move this earth right out of its orbit—provided the lever didn't bust. Old Archimedes wasn't particularly interested in moving the earth anyhow—all he wanted was a sensational way to explain how a crowbar works."

GUS SAYS—

BRAGGING about how you drove from here to there on so many gallons of gasoline doesn't mean anything. What counts is the day in and day out handling of your car so as to get the most miles out of every gallon you buy.

There's tricks to stretching your gas mileage besides setting the carburetor for a skinny mixture. For one thing, the more you use the brakes the lower goes the gas mileage. Every time you dash up to a crossing and slam on the brakes you might just as well take some gasoline out of the tank and spill it on the road. Trying to jump the other fellow to the getaway is another fine way to throw away gasoline. You'd be surprised how much gas is wasted by running on soft tires. Dragging brakes, wheels out of line, any other extra friction, hits you right in the gasoline pocketbook. And don't forget that the cheapest gas you can buy generally turns out to be the most expensive in the end.

"What's that got to do with the horsepower of an auto motor?" asked Joe.

"A whole lot," Gus answered. "A crowbar is nothing but a lever that fits the kind of power you have to the job that has to be done. You can, for instance, push with a force of one pound on the end of a lever and move it a distance of one foot. With the right fulcrum—which is the point where the lever braces against something solid—you can lift a weight of twelve pounds a distance of one inch. Or you could move the fulcrum nearer the weight and find a point where you could lift twenty-four pounds a half inch. An automobile is just full of levers, only most of 'em aren't like crowbars. They're gears, and gears really are continuous levers."

"STILL I don't see the connection between gears and horsepower," Joe objected again.

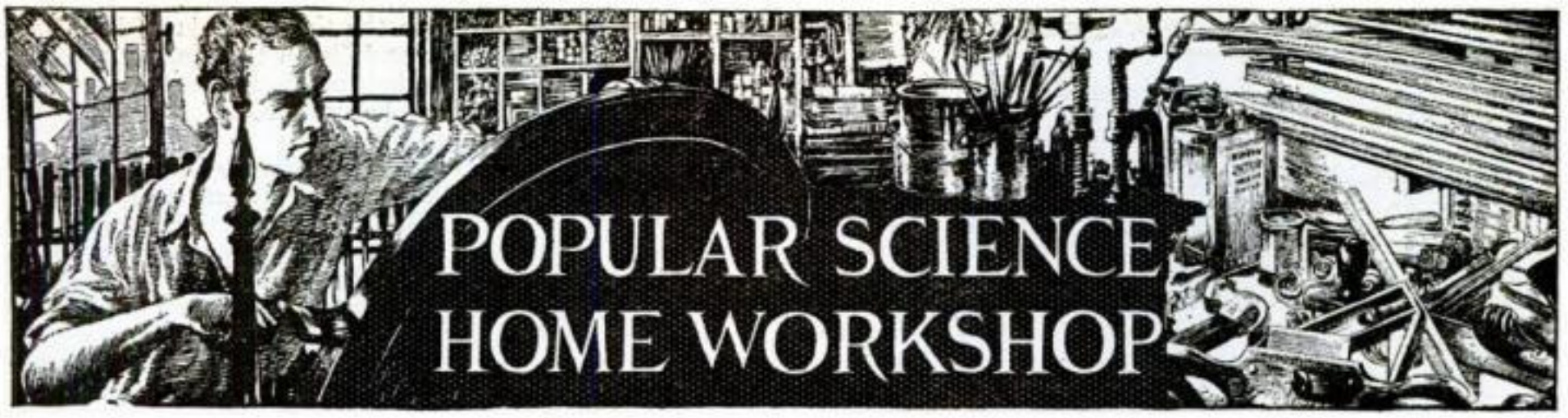
"You will in a minute," Gus continued. "A gasoline motor is a lot like a human being in some respects. With a lever you can lift a heavy weight that you couldn't budge if you grabbed hold of it direct. The gasoline motor turns the crank shaft with only so much turning force—called torque. So the motor is speeded up and by means of gears this fast, not-so-strong motion is turned into a slower movement with a lot of pull to it."

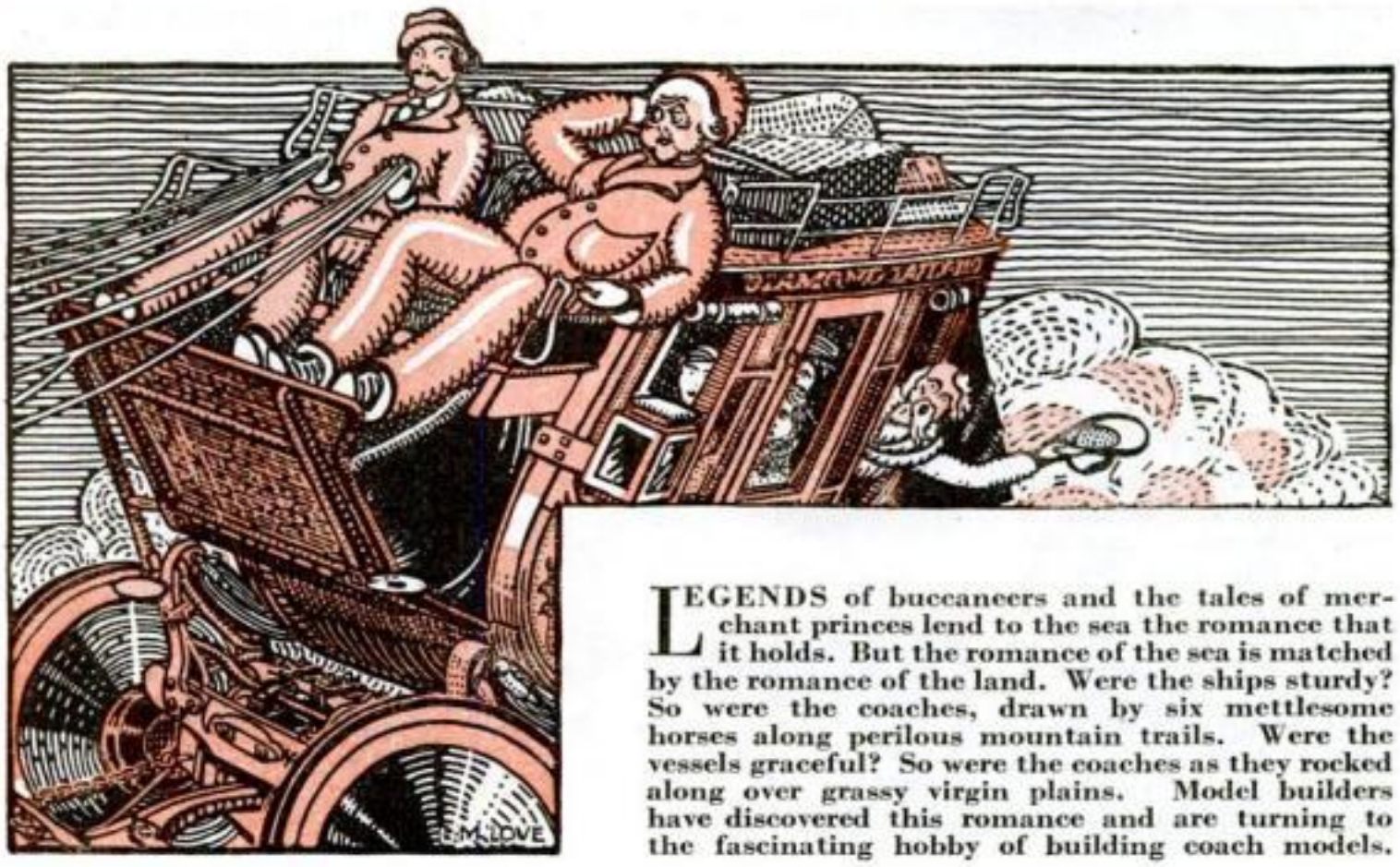
"Then it's the gears that determine the pull, and the horsepower hasn't anything to do with it?" Joe interrupted.

"If you're talking about just plain pull, that's right. By using extra low gearing you could drive a five-ton truck, fully loaded, up the side of a steep mountain with a one-horsepower motor. Of course it would barely crawl along—you'd have sacrificed speed to get the necessary pull."

"But couldn't you speed the motor to beat the band to make up for that?" Joe suggested.

"NOW you're getting into some of the ins and outs of engine design," smiled Gus. "That's what the engineers have been doing ever since the first gasoline engine was built. Instead of making bigger and bigger cylinders to get more power, they have let the cylinder size alone and obtained more power out of the same set of cylinders by making 'em work faster. Bigger valves, larger gas passages, higher compression, lighter moving parts, better balance have all been used to let the motor turn (*Continued on page 138*)





LEGENDS of buccaneers and the tales of merchant princes lend to the sea the romance that it holds. But the romance of the sea is matched by the romance of the land. Were the ships sturdy? So were the coaches, drawn by six mettlesome horses along perilous mountain trails. Were the vessels graceful? So were the coaches as they rocked along over grassy virgin plains. Model builders have discovered this romance and are turning to the fascinating hobby of building coach models.

Now—Model Stagecoaching

By EDWIN M. LOVE

LOCKED away in an old fair building in Balboa Park, San Diego, Calif., stands the *Diamond Tally-Ho*, a stagecoach that ran for many years between that city and the little mining town of Julian. It is stripped of lamps, curtains, and boot sides. The thinnest skin of flaked red paint and a dim tracery of gold are all that remain to indicate the decorations that once glorified it; but only structural ruin can rob the coach of the dignified beauty that lies in clean lines and well-proportioned masses. The *Diamond Tally-Ho* is a fine example of design from the leading carriage-making center of its time, Concord, N. H., and a splendid coach to copy in miniature.

While the original was christened "tally-ho," it is not, of course, the type of coach commonly called the tally-ho. It is a coach strictly typical of the vehicles that thundered along the mountain roads in the old West.

The model was built one eighth full size. Missing details have been supplied as accurately as possible, and the little coach is a piece having all the interest of a fine ship model.

Maple, or other fine-grained hardwood, is used, except as otherwise specified. Aluminum is excellent for metal parts where soldering is not required, but any common metal will do.

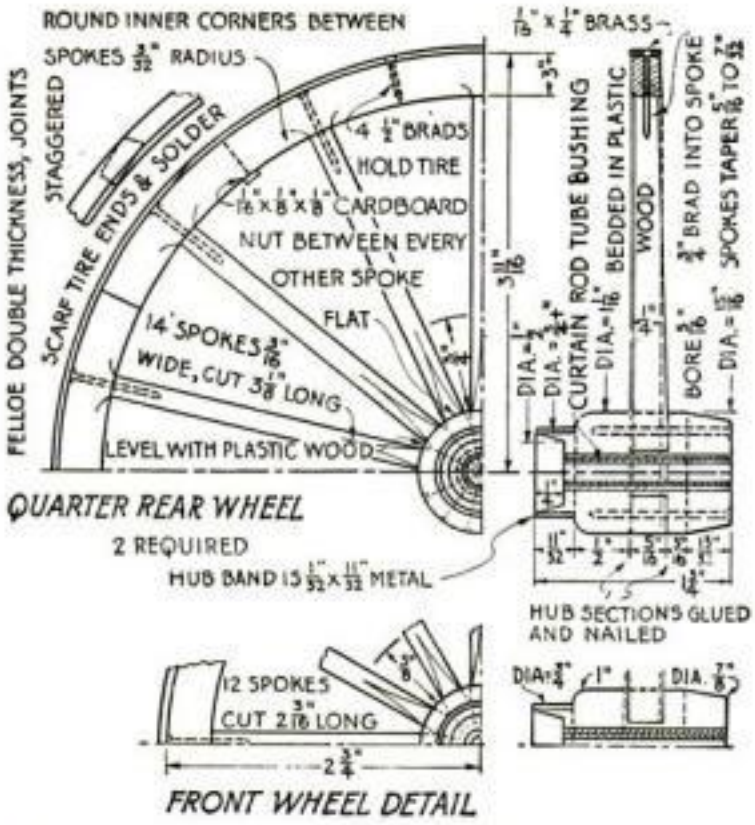
To help those who desire to build this model, detailed blueprints have been prepared and can be obtained by sending seventy-five cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 115, 116, and 117 (see page 97).

The original coach as it now appears, void of all color and trappings but still perfect in all essential details.

REAR WHEELS. *Felloes:* On a flat board scribe circles outlining the felloes. Divide the circles into seven equal parts by stepping it around with dividers, halve these divisions, and draw fourteen radii. Cut out the fourteen equal segments from 1/8 by 7/8 in. stock and tack seven of them together with brads so as to cover the felloe outlines. Glue the others on top, staggering the joints. When dry, scribe circles and cut along the outlines with a jig saw. (See drawing at top of page 78.)

Spokes: From 3/16-in. stock cut twenty-eight spokes, tapering them from 5/16 to 3/16 in. in diameter. With a rasp, file them to an oval shape from the thin ends to within 3/8 in. of butts, thus leaving pointed flats on each face. Finish them with sandpaper.

Make a form, with four brads to hold each spoke; taper the spoke butts, coat them with glue, lay them in the brad jig, glue them again, and tap the ends until they reach the



The construction of the front and rear wheels, showing location of the spokes and a section of the two-piece hub.

felloe lines and the butt tapers meet. Trim any projections beyond the felloe with a chisel. The wheels are not dished, the outer faces being flat, and the spokes are not staggered. When dry, force the felloe on, securing it with ¾-in. No. 20 brads driven into the spoke ends.

Hubs: Turn all sections in one piece, and cut them off to size on the lathe and square the ends. Bore the outer ends ¼ in. deep with a ½-in. bit and bore all the way through each hub with a 5/16-in. bit. Size the inner ends of the hubs with glue, and then glue and nail the outer sections in place. Remove the wheels from the jigs, and add the other hub sections, carefully lining them with the fronts. Level the hub spaces between spokes with plastic wood. With a sanding disk or block plane true the felloes, tapering them toward the edges. Round the inner corners between the spokes with sandpaper. (See drawing at left.)

Ironing: Bore a hub hole in a board, and place the wheel on it. Measure the circumference of the wheel with a strip of paper, allowing ⅜ in. for lapping, and cut a piece of 1/16 by ¼ in. brass to the same length. (Here and in most places where thin metal is specified, cardboard may be substituted and pasted in place. This saves a great deal of work and looks almost as well, but is not so workmanlike.) File the ends of the strip to tapering scarfs, coat them with soldering flux, and heat to anneal them. While they are hot, tin the scarfs with solder and then wrap the tire around the felloe and hold it in place with brads. When the scarfs meet smoothly, solder, and file the joint smooth. Remove the wheel, drill four evenly spaced No. 60 holes through the tire, drive in ½-in. No. 20 brads, and file off the projecting heads.

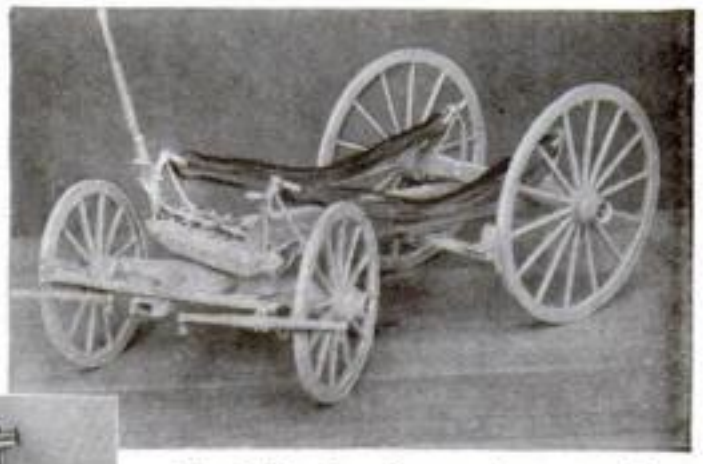
The hub bands are held for soldering with a heavy wire looped around and twisted.

Glue 1/16 by ⅛ in. cardboard "nuts" to the felloe between alternate spokes.

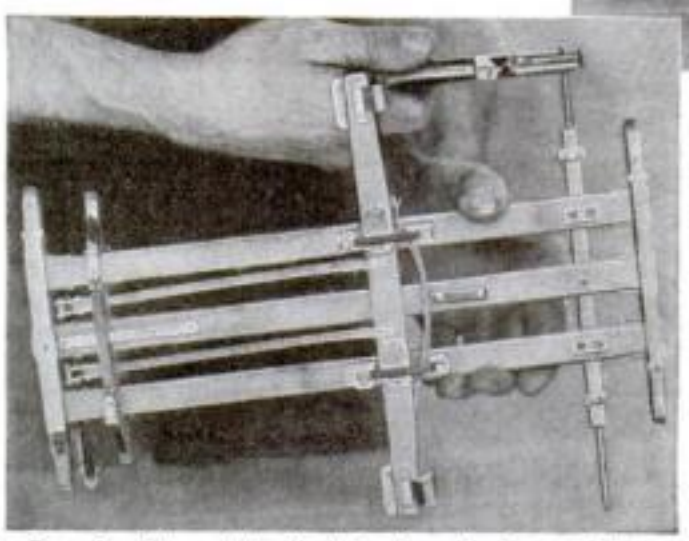
FRONT WHEELS. The front wheels are identical with the rear ones except that they have only twelve spokes and twelve felloe sections and are 5½ in. in diameter.

BOLTS AND NUTS. Center-punch and drill metal of the proper thickness and size, and place them by driving brads through the holes.

REACHES. In the drawing below is illustrated the construction of the reaches.



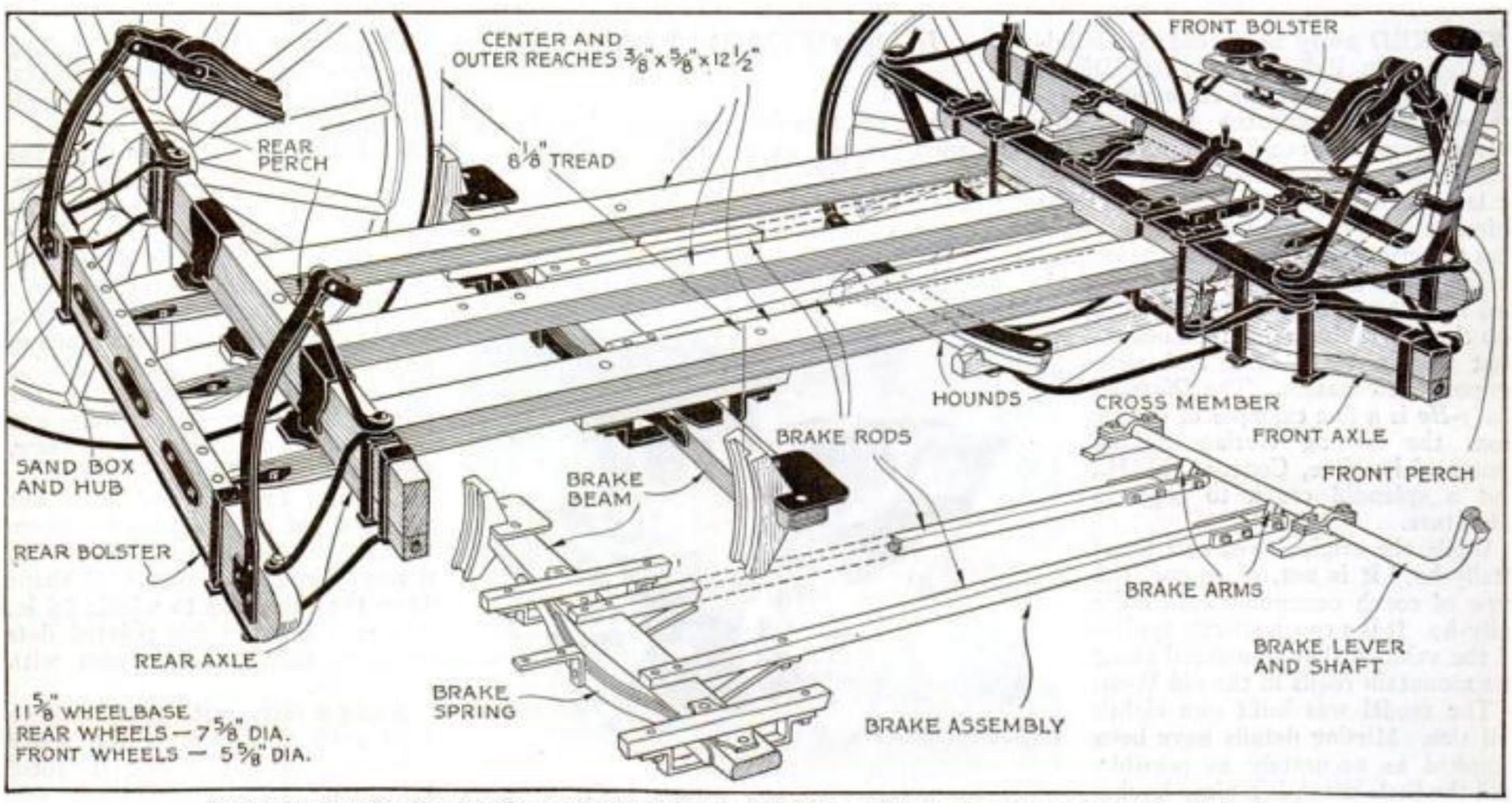
The finished carriage ready to receive the body part of the stagecoach model.



Screwing the axle bolts into the axle frame. Note the underconstruction of the brake mechanism.

"Bolt" the drawbolts, which join reaches and bolsters, to the sides, and drill bolster-nail holes above the center in the side reaches and below the center in the center reach, so as to avoid striking. The three plates on each bolster can be shaped with snips and file. The brake spring is riveted at right angles to the "L" bolted under the center reach. Use spring brass if conveniently at hand.

BOLSTERS. The curved ends of



Perspective drawing showing the construction of the assembled carriage, and a separate sketch of the brake mechanism. Detailed drawings can be obtained by sending seventy-five cents for Blueprints Nos. 115, 116, and 117.

Doubletree and singletrees and assembly of the hounds and ironwork as viewed from above.

the bolsters are tapered and rounded on the faces. Snip the clips from thin stock and file them round on the ends where they pass through the yokes and nuts. Clamp them firmly while riveting the nuts. Attach the bolsters to the reaches with heavy 1-in. brads, placed so that the outer reach tops are 1/8 in. below the bolster tops. The center reach is parallel to the others, and 3/32 in. below them. The pointed plates center on the bolsters, covering the nailheads.

AXLES. *Front:* The upper sand plate and axle are forged from solder. Thread curtain rod spindles and screw them into holes drilled and tapped in the metal axles.

Rear: The rear axle is held in place on the reaches with nails placed under the large clips. These are made from thin metal by hammering them up from the back with a blunt cold chisel.

Sand Boxes: These are wooden disks 1/8 in. thick, having curved strips of cardboard glued around them. These disks are then drilled to go over the spindles and are nailed to the ends of the wood axle beds.

BRAKES. *Iron:* Make the throw-arms of brass, hollow the butts, file the iron bright where they join, and bind them in place with fine wire, making an angle of 45° with the arm. Solder them in place, remove the wire, and trim them to shape.

Handle: The handle is made of maple and has a leather jacket and a foot plate on its thin end. Nail the handle to the iron bracket and add a metal clasp and clip.

Rods: The clevis plates are held in position by No. 20 brads which pass clear through and are riveted over the nuts. The other ends of the rods join in a half-lap on the beam. Add the under straps, and bolt the clevises to the levers.

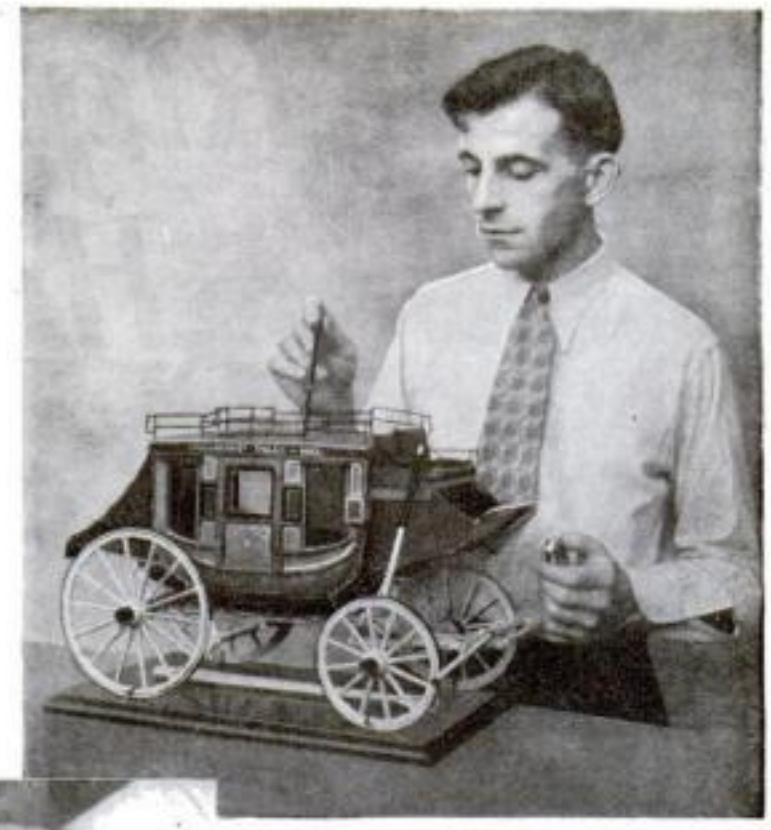
Beam: The straight edge of the beam is forward. Center the rub plates on the reaches and fasten them in place. Nail the brake blocks to the notches after canting them to fit the wheels. Add nuts and cardboard washers and the steps and then bolt the completed beam to the rods.

Bearings: Cut the stock long, shape, punch holes, trim to length, and bolt in place.

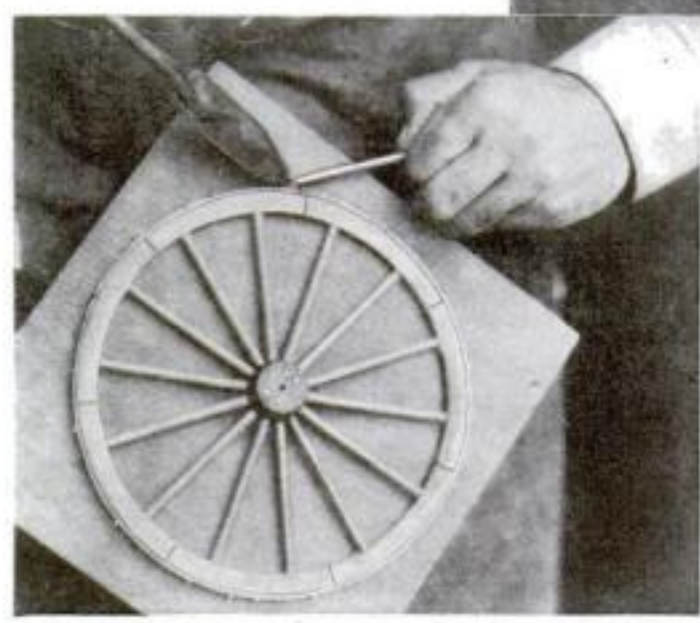
Slides: The slide plates are bradded to their respective shims on the outer reaches, and to these are bolted the slides. (See drawing bottom of page 78.) Rectangular eyes may be placed at the forward ends, but are just as well omitted.

HOUNDS. Trace the wooden parts from cardboard templates, saw them out, and finish smooth. These are then glued in the axle mortises. The sides of the curved segment of the hounds are rounded toward the underside, and a curve is cut from the underside between the hounds. The upper member, carrying the metal plate, is glued in place with the front edge projecting 1/16 in. Chamfer the upper corners of the hounds behind the segment.

Irons: Place upper and lower plates, add the front ferrule, and put on the under braces, which are bent into eyes at the rear ends, flattened at the axle, and bent into long, flat loops in front. The side braces are flattened and bent into clasps fitting the axle ends, also gripping the sand box clips. The other ends fit into holes in the hounds, and the flattened portions are imitated with metal plates. Finish nails driven through these and the hounds serve as bolts.



Mr. Love, distinguished craftsman and designer, putting on the finishing touches.



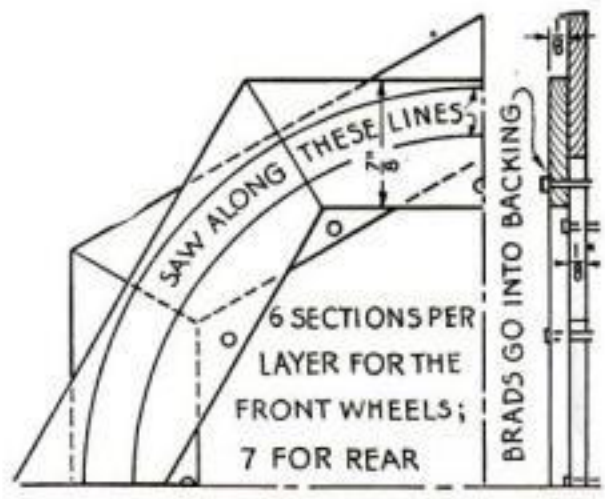
Soldering the lap joint on the metal tire while it is held in place around the wood felloe with brads.

TONGUE. The front eye is made of wire, and has its ends sunk into the wood. The flattened shanks of this iron are made of wood. The hooks are made from nails, the large one entering the tongue.

DOUBLE- AND SINGLETREES. Clinch the doubletree center plate nails on the underside and file them smooth. Rivet the step plate iron in place with nails and supply nuts for the underside. The singletrees are round, tapering gradually to square ends and reënforced by thin ferrules having their joints in the back. The trace hooks are spirals having their points crossing above. The U-bolts pass through plates which are shaped to fit the curve and placed on both sides of the tree.

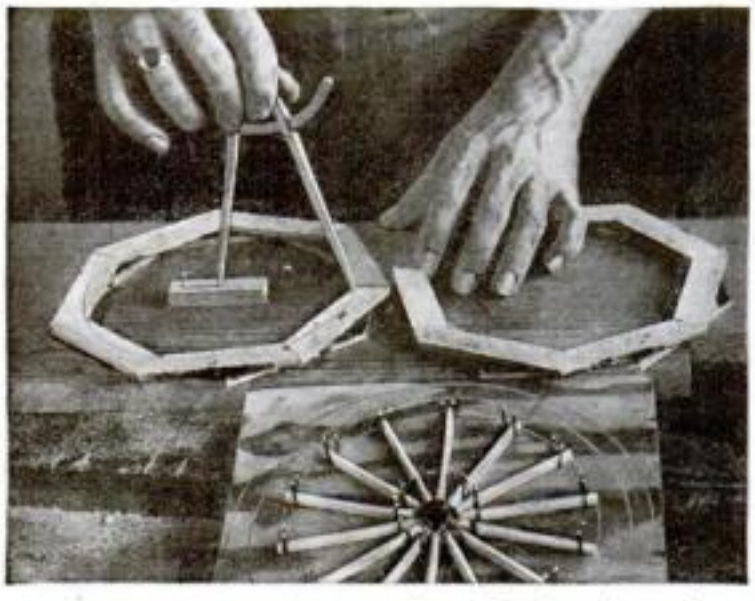
REACH CROSS MEMBER. The upper and lower irons are made by hammering a piece of solder to the shape required. The wooden beds are notched to fit the reaches. Solder the irons together, force them into the beds, and nail them in place with brads. The U-bolts rivet into solder nuts, the end U's being prevented from sliding off by clips that clasp them and are bolted under the iron.

Next month the construction of the body of the coach will be described.



FELLOE CONSTRUCTION

How the stock for the felloes is glued and held temporarily with brads.



Scribing the felloes prior to cutting. Note how the spokes are held in place with brads during the assembling process.

All the carriage building terms which are not self-explanatory will be found clearly marked on Blueprints 115, 116, and 117.

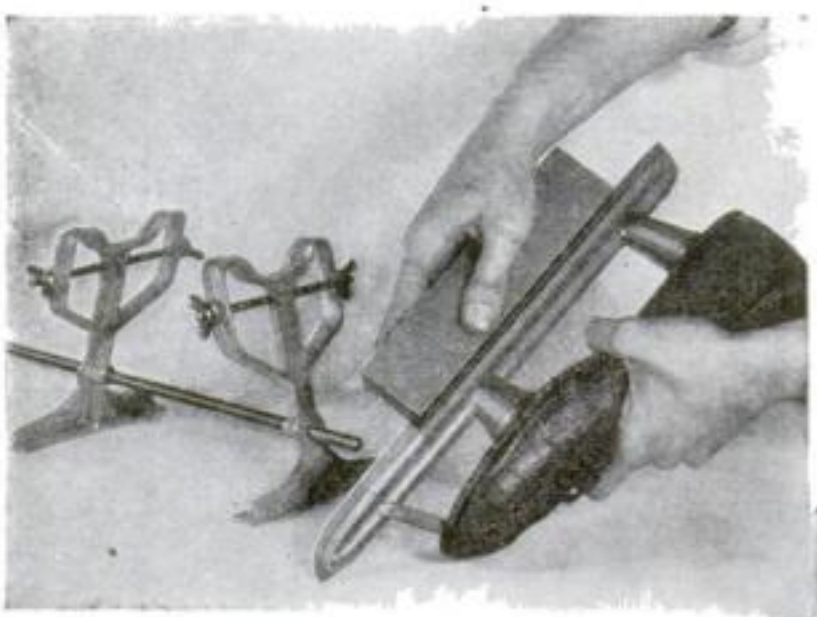
This model was designed and built especially for POPULAR SCIENCE MONTHLY readers at an unusual expenditure of time and effort. Would you like to see more material of the same kind? Let the Home Workshop Editor know what model you wish next.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

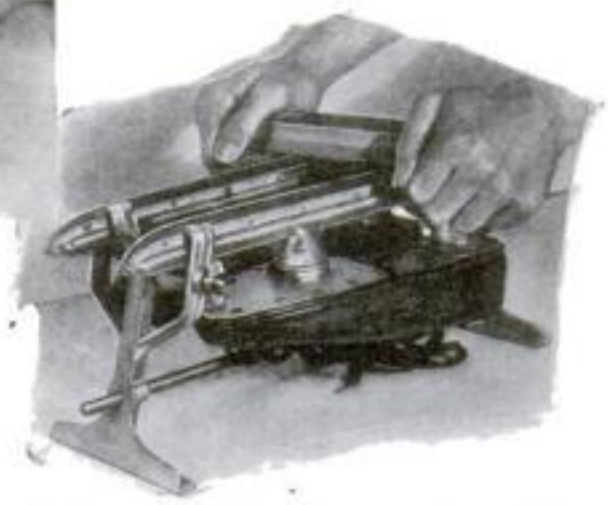
Skates, Skis, and Ice Boats

How to Sharpen Thin-Bladed Tubular Runners— Keeping Bent Wood in Shape and Other Hints

By
GEORGE H. VAN WALTHER



Removing the burr formed in blocking by drawing the smooth side of the stone along each side of the skate.



The stone is moved so as to form a figure eight, the cross being at the center of the blades.

ESPECIALLY true of winter sports—skating, skiing, and ice boating—is the statement that success depends upon keeping ones equipment in first-class condition.

Skates with the old-fashioned wide blade were ground at the beginning of the season and not touched again for the remainder of the winter. With the advent of the tubular skate and the thin blade, the process of sharpening has become a more important operation. Some racers recondition their skates after each day's use in order that the edges will be ready for the next spin across the ice.

Tubular skates are blocked, not ground. This method of sharpening requires a jig and a flat carborundum or other oilstone. The jigs are made of both wood and metal, but because of the tendency of wood to warp, the cast metal blocks are better.

The skates are set in recesses in the top of the jig and held in place by tightening four wing nuts. It is essential that the skates be held firmly; and the jig must rest on an even base, if it has not been fastened to a table or bench.

The carborundum or oilstones used for the sharpening have a coarse and a fine side. The first part of the blocking operation is done with the coarse side.

First test the blades for trueness and squareness. This is accomplished by drawing the stone across the blades at right angles to the skates. If they are true, lines will be cut across the top of the blades. Test the edges at several places in this way, thus ascertaining just where the blade is high and where it is low, and obtaining a guide as to how much of the blade must be removed.

In doing the actual blocking, apply a light oil to the coarse side of the stone and draw the stone across the blades so as to form a figure eight, the crossing point of the eight being at about the center of the blades. Continue this form of cut until the blades are found to be true across. Racing skates should have no "rock," so the lengthwise trueness can be tested with a straightedge.

For the second cut, which should true up the blades lengthwise, two figure-eight motions are used, one from the middle to the toe of the skate and the other from the middle to the heel of the skate. Test the keenness of the edge frequently by drawing the back of a finger nail across the edge. If the corner of the blade will shave the finger nail without any great amount of pressure, the blade can be considered fairly sharp.

For the finishing cut, turn the stone over so as to use the fine side, apply oil, and go over the entire edge of the skate with many small figure-eight motions. When all of the deep cuts made by the coarser side have disappeared, draw the stone down the whole length of the blades, slipping it sidewise slightly.

To remove the small burr on the edges, hold the fine side of the stone against each side of each blade and move it back and forth. Be sure that the stone is flush against each side so as not to round the sharpened edges.

After the stone has been used several times, you will find that the pores have become clogged, making the surface smooth and thus impairing its cutting qualities. When this happens, wash the stone in kerosene and rub it briskly with a stiff brush. This will remove all dirt, oil, and fine bits of steel and bring the cutting surfaces back to their original clean condition.

Oilstones will become uneven in time and should be replaced as soon as signs of wear show in the form of ridges.

THE care of skis presents still another problem. Skis have a certain amount of bow in them to counteract the weight of the user, the amount varying with the type of ski; but every ski has it and every ski should retain it. The natural tendency is for the user, at the end of a winter season, to stand the skis up in a corner and forget them until the first snow of the next year. Wood warps, and if skis are left resting on their ends, they will, without a doubt, either twist or lose their correct amount of curvature. At the end of the winter months, therefore, it is well to strap the skis together, snow face against snow face. Place a strap at each end and put a block of the right size in the center at the bow, holding it there with a strap. This will prevent the runner from twisting and maintain the curvature.

In order to get the best use out of your skis during the actual season, the running surfaces must be coated frequently with a wax preparation to prevent damp snow from sticking to the wooden surfaces. Most experienced ski runners carry a cake of this prepared wax with them. Many of these wax preparations are sold commercially, but a very good wax can be easily made by melting a mixture of rosin and beeswax in the proportions of about one to two. Pour the mixture into a wooden mold made to the shape desired and allow the wax to harden. In this way convenient sized cakes can be made.

The care of an ice boat is somewhat the same as the care of a sailboat. Before the season starts, it is well to varnish the frame and see that the sail is in good condition and that the runners are free from rust and tight in the frame. In the use of an ice boat there is one important precaution—do not allow the boat to rest on the ice overnight. The weight will force the sharp runners into the ice and they will freeze fast in a very short time. A neat way of preventing this is to rest the boat on blocks of a length sufficient to free the runners from the ice.

If for some reason the sails become wet or damp, do not roll them but take them down and hang them in a warm room. If rolled and left out even for a short time, the sails may freeze up and the fabric ultimately may be ruined.

Chemistry attacks house-work

reduces dusting 50%

Floors, too, now cleaned without scrubbing, as chemist experiments with everyday products

FREE 25c CAN OF JOHNSON'S WAX sent for trial

Chemistry goes to work on ordinary household problems and cuts dusting in half. Scratches and stains on chairs, tables, and woodwork can also be avoided. Floors cleaned and kept clean without scrubbing.

These are the latest contributions of a science that attacks old problems with astonishing results.

Less dust will accumulate on a waxed surface than on a sticky one. But *how much less?* Tests showed that dust cannot cling to the hard dry film of Johnson's Wax at all.

Whatever particles settle there are whisked off, largely by the ordinary air currents in the room. In a perfectly "still" room, fifty per cent less dust remained on the waxed panels than on the oiled panels.

On floors, the hard dry film of wax keeps the dust on top where it is easily removed by light dusting. How to clean floors (where traffic is heavy) without scrubbing is explained in a new booklet, "Reducing the Care of Floors and Furniture," we will be glad to send to householders, on request.

You will also receive a 25c can of Johnson's Wax free as a demonstration. Just use coupon.

For Home Carpenters Johnson's reliable Wood Dyes settle the ticklish question of the proper finish. *In all colors.* Bring out the natural beauty of the grain. Dry quickly. Never smudge or rub off. Enable you to have the beauty of the finest hardwoods on inexpensive softwoods. Guaranteed not to raise the grain. At hardware and paint stores.

Dust Under Microscope Illustration at left shows section of panel treated with Johnson's Wax; at right, panel with ordinary oil polish. Note how dust particles (half as many) rest on top of waxed panel where they can be easily whisked off by light dusting. On oiled panel, particles have sunk into the film and become embedded. Both panels were exposed to the same amount of dust in the same room for the same length of time.

Ink Penetration Test: Showing cross section of three panels treated respectively with Johnson's Wax and two oil polishes. One drop of ink was placed on each panel. Chemist's drawing shows how ink did not penetrate hard wax film, but seeped into polish A and B with resultant discoloration of wood.

S. C. JOHNSON & SON, Dept. PS2 Racine, Wisc.

Gentlemen: Please send free 25c can (not a sample) of Johnson's Liquid Wax for dust demonstration and illustrated booklet, "Reducing the Care of Floors and Furniture."

Name_____ (PLEASE PRINT)

Address_____

City_____ State_____

Ever Drive into the Garage Wall?

How to Build a Timber Stop That May Save a Costly Crash—Other Ideas Car Owners Have Found Useful

MOST home garages are lightly constructed. While strong enough to resist ordinary strain, the entire back wall of the garage may be wrecked by a blow from the car bumper so light that the bumper itself is not damaged.

Figure 1 shows how to make a stop to avoid such trouble. A six by six timber long enough to extend ten inches on each side of the wheels can be bolted permanently with lag screws into a wooden floor or into expansion shields in holes in a concrete floor. To make the stop removable, ten-inch pieces of one-inch diameter pipe can be set into the floor to form sockets into which three-quarter-inch pieces of pipe will fit.

The three-quarter-inch pieces of pipe will make a drive fit in an 11/16-inch hole drilled through the timber. Be sure to plane off the sharp edge of the timber toward the garage door so that the tires will strike against a flat surface instead of a sharp edge. If the floor space is somewhat restricted, make the bumper removable so as to facilitate tire changes and work under the rear of the car.

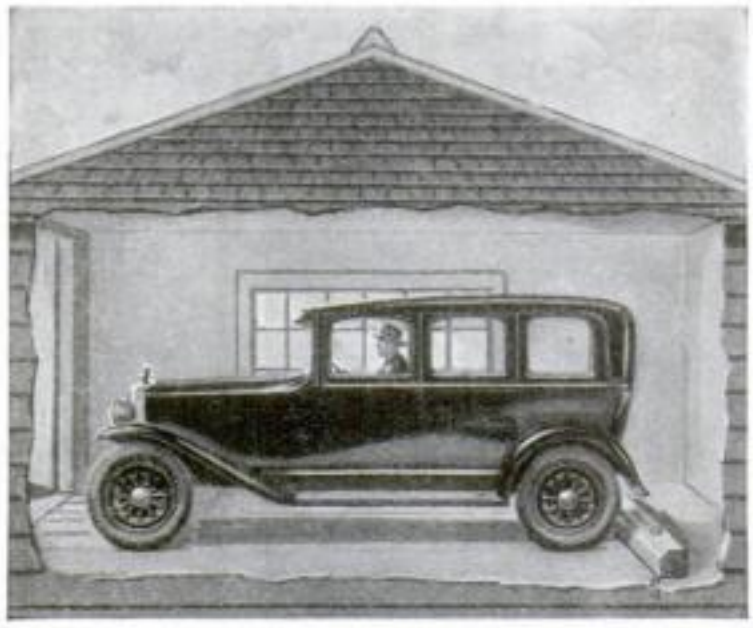


Fig. 1. A timber stop, bolted to the floor at rear of the garage, prevents ramming the rear wall when driving in.

Repairing Broken Brush Springs

SOMETIMES a break in a spring that presses a brush against the commutator on the starting motor makes the starter inoperative. Figure 2 shows a temporary repair. Cut a strip of rubber from an inner tube and pass it through the openings in the motor frame as shown. Pull fairly tightly and tie a knot. The rubber band will press the brush against the commutator and permit the motor to start the engine in normal fashion.

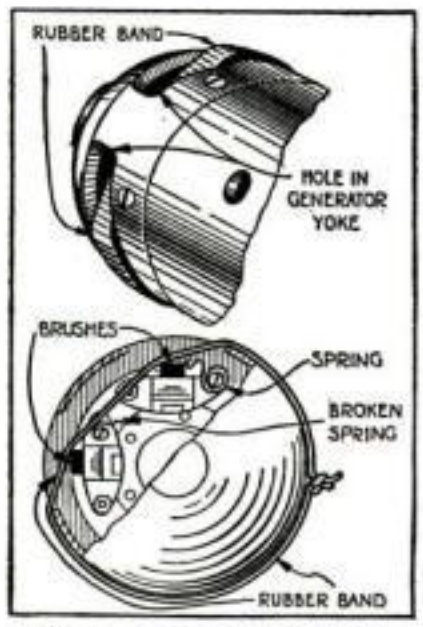


Fig. 2. Broken brush spring is repaired with rubber band.

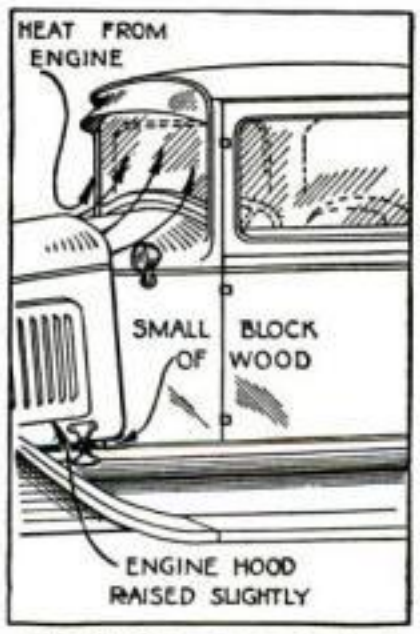


Fig. 4. A wedge under hood sends hot air to windshield.

Mousetrap Burglar Alarm

AN ORDINARY mousetrap (Figure 3) can be converted into an effective auto burglar alarm. Two wires with spring clips attached to their outer ends are attached as indicated. One clip is attached to the live terminal of the horn and the other to the metal frame of the car. When the trap is set the circuit is open. When sprung, the circuit is closed and the horn blows continuously. The trap can be placed so that moving either the steering arm or clutch pedal will spring the trigger.

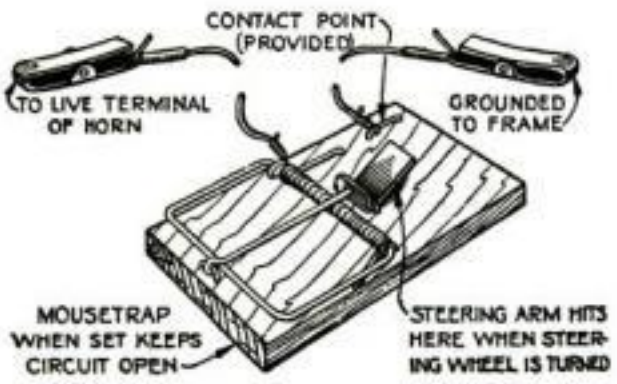


Fig. 3. How mousetrap alarm is set to blow the horn if thief moves the steering wheel.

Each month POPULAR SCIENCE MONTHLY awards a prize of $10, in addition to regular space rates, for the best idea for motorists. This month's prize goes to Harold Beedle, Clear Lake, Ia., for his suggestion for keeping the windshield clear (shown in Figure 4).

Clearing the Windshield

A CONSTANT stream of warm air can be directed against the windshield to prevent fogging and frosting (Figure 4). Raise the rear edge of the engine hood on each side enough to insert a small block of wood. This will produce an opening along the top rear edge of the hood through which heated air from the engine flows and strikes the glass. If trouble is experienced with rattling, an extra block of wood of the right size should be placed directly under the edge of the hood near the hinge. Experience will show what size block to use for best results.

Simple Hood Rest

FIGURE 5 shows an easy way to make a rest for the hood when it is opened. The only mechanical work needed is the hack-sawed slot in the edge of the cowl and two holes for bolts that hold the angle pieces to the dash. The straight piece and the two angle pieces are stock items from standard toy mechanical construction sets.

Cut the slot in the cowl first and then locate the angle pieces so that the perforated straight piece will swing into the slot in the up position or hang down out of the way when not in use. At least two hood rests will be required, one on each side; some hoods will require four.

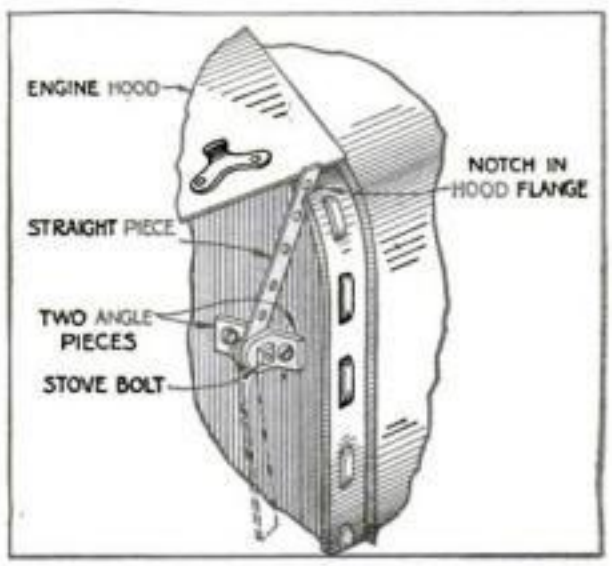
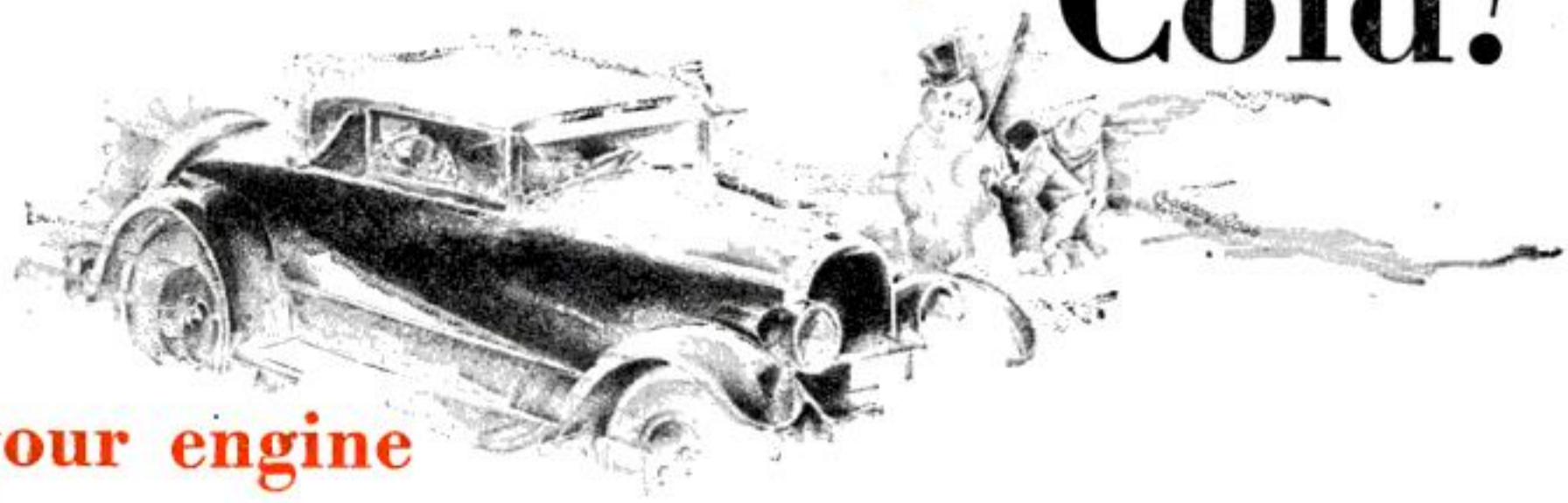


Fig. 5. A simple and easy method of constructing a rest for the engine hood when it is opened.

While the weather man says "Cold!"



your engine demands the double-range protection of Mobiloil Arctic

Two of the most dangerous enemies your battery and engine can have are "summer-oil-in-winter," or a winter oil which is so light that it lacks rich lubricating value.

With too heavy a lubricant the thick oil lies, stiffened by cold, in your crankcase. After standing in the cold, your engine strains to overcome the resistance of "dry" pistons, cylinder-walls and bearings. Your battery can waste hours of its life in those few moments of terrific effort.

With too light an oil in your crankcase you get easy starting—but when your engine heats up, such oil may show a serious lack of lubricating value.

The new Mobiloil Arctic gives efficient lubrication from the first turn.

In its ability to meet your two cold-weather needs Mobiloil Arctic is unique.

1. Its correct body, and fluidity at zero assures easy starting and quick oil circulation.
2. It retains its rich lubricating value at your highest winter operating temperatures — thus assuring full protection no matter how fast or how far you drive.

Mobiloil Arctic has been tested and proved by millions of motorists in every cold country from Norway to Cape Horn. When you change to Mobiloil Arctic you end every doubt about the correctness of your winter lubrication.

VACUUM OIL COMPANY
Makers of high quality lubricants for all types of machinery

Make this chart your guide

It shows the correct grade of Gargoyle Mobiloil for certain prominent cars. If your car is not listed below, see complete Mobiloil Chart at your Mobiloil dealer's.

Follow winter recommendations when temperatures from 32° F. (Freezing) to 0° F. (zero) prevail. Below zero use Gargoyle Mobiloil Arctic (except Ford, Models T, TT, use Gargoyle Mobiloil "E").

NAMES OF PASSENGER CARS	1929 Engine		1928 Engine		1927 Engine		1926 Engine	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Auburn, 6-66	BB	Arc.	BB	Arc.	BB	Arc.	A	A
" 8-cyl.	A	Arc.	A	Arc.	A	Arc.	A	Arc
" other models	BB	Arc.	BB	Arc.	BB	Arc.	A	A
Buick	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Cadillac			A	Arc.	A	A		
Chandler Special Six	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chevrolet			A	Arc.	A	Arc.	A	Arc.
Chrysler, 4-cyl.	BB	Arc.	BB	Arc.	A	A	A	A
" Imperial 80 and Imperial	A	Arc.	A	Arc.	A	A	A	A
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Dodge Brothers	A	Arc.	A	Arc.			A	Arc.
Durant	BB	Arc.	BB	Arc.	BB	Arc.	A	A
Elcar, 8-cyl.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" other models	A	Arc.	A	Arc.	A	Arc.	A	A
Erskine	A	Arc.	A	Arc.	A	Arc.		
Essex	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Ford, Model A	A	Arc.	A	Arc.				
" Model T					E	E	E	E
Franklin	BB	Arc.	BB	Arc.	BB	BB	BB	BB
Gardner, 8-cyl.	BB	Arc.	BB	Arc.	BB	Arc.	A	Arc.
" other models							A	A
Hudson	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile	BB	Arc.	BB	Arc.	A	Arc.	A	Arc.
La Salle	BB	Arc.	BB	Arc.	BB	Arc.		
Lincoln	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Marmon, 8-cyl.	A	Arc.	A	Arc.	A	Arc.		
" other models			BB	A	A	A	A	A
Moon	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Nash, Adv. & Sp. 6	BB	Arc.	BB	Arc.	BB	Arc.	A	Arc.
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Oakland	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Oldsmobile	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Packard	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Peerless, 72, 90, 91	BB	A	BB	A	BB	A	BB	A
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Pontiac	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Studebaker	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Whippet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Willys-Knight, 4-cyl.							B	Arc.
" 6-cyl.	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.

the New Mobiloil ARCTIC

New Ease in Gear Shifting

While your oil is being changed, have the transmission and differential drained as well. Then have them refilled with Mobiloil "CW" Gear Lubricant. The new Mobiloil "CW" remains fluid on the coldest days, and always gives rich lubrication. It makes gears easy to shift and further lightens the winter load on your engine.

Fig. 1. The materials used in building this boudoir chair cost less than five dollars.

Cutting Curves on a Small Band Saw

Construction of Boudoir Chair Gives Practice in Use of Motorized Tools

By WILLIAM W. KLENKE

MOTORIZING the home workshop has made it possible for the amateur craftsman to construct many furniture projects—such as the boudoir side chair illustrated in Fig. 1—which are more elaborate and attractive than those that ordinarily can be made by hand.

With the advent of small motor-driven machines, however, has come the need of knowing how to operate and care for them.

A small band saw is particularly useful for curved cutting like that required in making a graceful chair. After a little practicing has been done the back legs of the chair shown can be sawed out almost as easily as a woman sews a seam on a sewing machine.

Many woodworkers who have had some experience in the use of band saws do not know how to twist the saw blade into three loops, which is the usual way of storing or shipping them. Hold the saw in the palms of your hands, teeth pointing outward, and allow a portion of it to rest on the floor. Let the saw form an ellipse. Place your feet on the blade and give the hands a twist inward so as to make the teeth above the feet point inward; drop the saw blade and you will find it in the three loops. Fig. 3 shows the operation clearly.

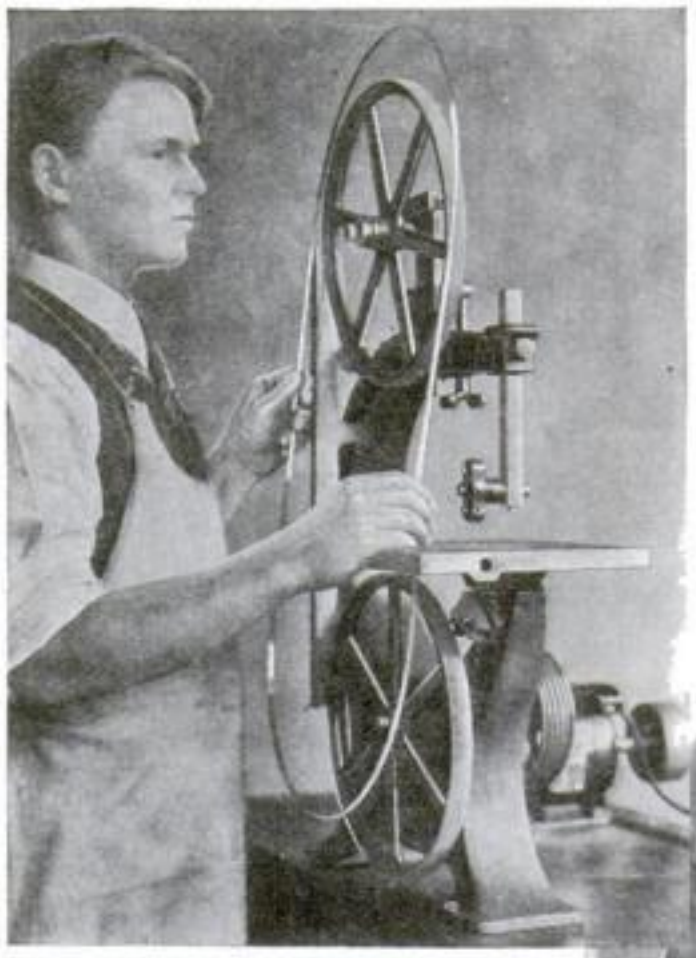


Fig. 2. The upper wheel is lowered enough to allow the blade to be slipped on easily.

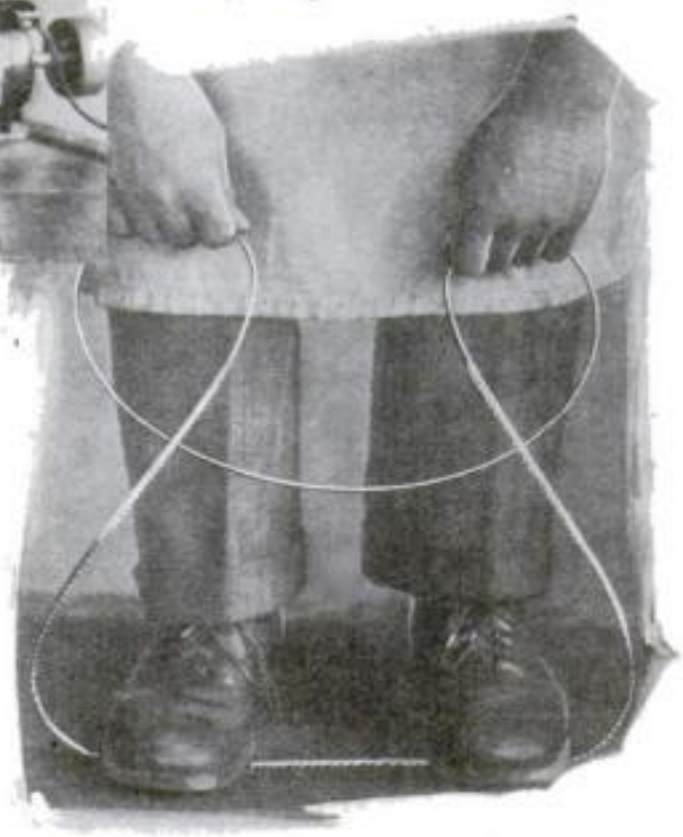


Fig. 3. The manner of twisting the blade into three loops, the customary way of storing or shipping it.

Fig. 4. Adjusting the blade to the proper tension, in this case by raising the upper wheel.

In putting the blade in place, lower the top wheel as far as it will go or sufficiently to allow the blade to be slipped over the wheels. Place the saw on the top wheel first and see that the teeth point forward and down. Then work it on the bottom wheel, revolving the wheels by hand, as in Fig. 2. Next adjust the upper wheel as shown in Fig. 4, working the handwheel with the left hand and feeling for the tension with the right hand.

Revolve the wheel a dozen times to see if the saw blade is running in the center of the wheel rims. If it does not run true, it is an easy matter to tilt the top wheel in either direction by turning the adjusting knob in the center of the top wheel. This adjustment is being made in Fig. 5. When the blade runs true, examine the guides carefully to be sure that they are supporting the blade.

The table on most band saws can be tilted at an angle when necessary by a few turns on the machine screw under the table in the back part of the machine, as is shown in Fig. 6. See that the table is firmly fastened before starting work. Set the saw guide to the proper height to allow the wood to pass under.

There are only a few safety precautions to observe in running a band saw. First of all, have a good guard on the machine; there is none shown in the illustrations, as it was easier to demonstrate the various operations without one. Always spin the saw around a few times by hand to make certain that everything is as it should be. Do not allow anyone to stand at the side of the machine while it is running. Be sure to keep the machine well oiled at all times.

The actual sawing on this machine requires little practice. No matter what happens, never back out of a cut; to do so may pull the saw blade off. If you get off the line, do not twist the wood but pull it towards you and start that portion of the cut over again.

Step No. 1—Patterns. From the working drawing, Fig. 7, make full size patterns of the back legs and curved rails in the

New Book, "You Can Make It"

Showing How to Utilize Boxes and Odd Lumber, Sent Free

DISSTON, the world's foremost makers of saws, co-operates with the Department of Commerce to lessen waste of lumber. Millions of boxes, now thrown away, may be used to make useful articles for the home, garden trellises and frames, bird houses, tool chests, work benches, plant boxes, kites, toys, etc.

To promote better uses of odd pieces of lumber, now burned or thrown away, Disston will send you without charge the new book, "You Can Make It," issued by the National Committee on Wood Utilization—52 helpful pages, more than 100 drawings.

To make the useful articles shown in this valuable book you will, of course, want Disston Saws, Tools, and Files. There is no substitute for Disston quality.

For Cutting Dovetails, etc.

Wherever the finest possible joint is needed, and for dovetailing, pattern making, etc., use a Disston No. 68 Dovetail Saw. Blade extra thin, with fine teeth. The 8" blade, 17 points to inch, is most popular. $1.60.

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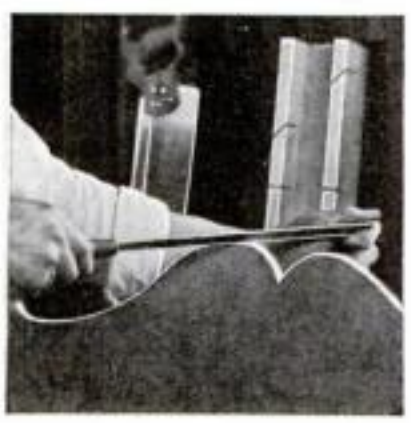
For giving a fine finish to your work, removing paint, etc., use a Disston Acme Cabinet Scraper, made of Disston Saw Steel. Made in all needed sizes, 2½" and 2⅞" wide and 5" and 6" long being standard. 30c and up.



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Disston Cabinet Files (fine teeth) for smoothing and finishing wood surfaces, easing tight doors and drawers, etc. Disston Wood Rasps (coarse teeth) for rough and fast cutting, enlarging holes, etc. Half-round 8" Cabinet File, 65c. Flat 8" Wood Rasp, 50c.

THE amateur mechanic, always glad to get new ideas, plans and working drawings for making things in his home workshop, will want both the new book, "You Can Make It," and "The Disston Saw, Tool, and File Book."

"You Can Make It" tells *what* to make. "The Disston Saw, Tool and File Book" tells *what tools* to choose for the job.

All Disston Saws are made of Disston Steel, from Disston's own steel furnaces. Disston Steel puts stamina, toughness and long cutting life into them. This better steel takes and holds a better temper: a *live* temper, which, while hard, is tough, yet readily filed and set. With this temper, a Disston saw takes and *holds* a keener cutting edge.

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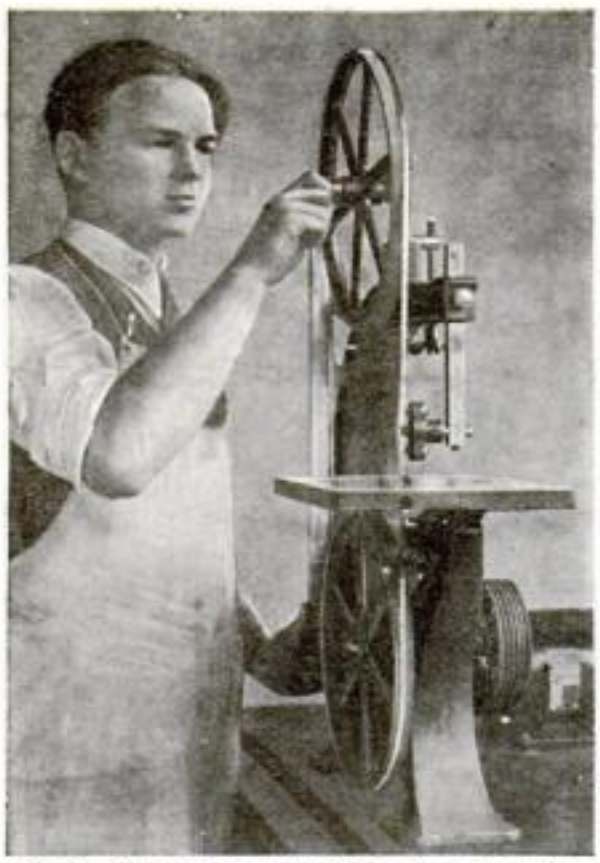

Fig. 5. The wheels should be aligned so that the blade will run in the center of each rim.

back section. Use heavy wrapping paper or cardboard.

Step No. 2—Seat Plan. On a board or paper, lay out the seat plan to full size, so that you can obtain the correct angles for the joints on the rails.

Step No. 3—Cutting Out. Transfer the curved patterns to the wood and cut out the back legs and rails on the band saw.

Step No. 4—Turning. Turn the front legs on the lathe and do the fluting by a special machine if you have one, otherwise cut the flutes by hand. The sanding can be done most efficiently in the lathe.

Step No. 5—Rails and Joints. Cut all of the rails to the correct size by means of the jointer and circular saw, being careful to cut the joints to match the layout.

Step No. 6—Smoothing Curves. A drum sander can be used for smoothing up the curves on the back legs and rails.

Step No. 7—Joints. Bore all holes in the legs and rails, after first having located the centers accurately. Mortise and tenon joints can be used, if so desired.

Step No. 8—Assembly. Make a trial fitting of all parts between clamps, to make sure that all members will fit. The two front legs and rail are glued together, and then the two back legs and rail. When the glue has set, assemble the entire chair. In order to obtain the same angle on both sides of the seat, the squaring must be done as follows: Locate the center of the back and front rails and place a square on the frame; when these two center points line up the angles will be identical. Corner blocks are securely fastened in place and a separate frame made for the upholstery.

Step No. 9—Cleaning Up. Clean off all of the excess glue with a chisel and Nos. 0 and 00 sandpaper. All parts should be sandpapered before assembling. Slightly round all sharp edges.

Step No. 10—Finish. As this chair can be made of any close-grained wood, various methods of finish are possible, including two for antique maple, two for genuine Mexican mahogany, and one that will give birch, maple, cherry, and the like the appearance of other woods, such as mahogany and walnut.

While there are various ways of finishing mahogany, two are outstanding. In the first case, buy a high-grade mahogany water stain powder and dissolve according to directions or use a prepared wood stain or dye of first quality. Apply a liberal coat with a brush. Allow the stain to dry thoroughly and apply a very thin coat of white shellac. Sandpaper when dry with No. 00 sandpaper and apply two coats of paste wood filler, following the directions found on the can. Allow at least two full days after the last coat for the filler to harden (a longer time is better). Now apply three thin coats of white shellac, rubbing each coat when dry with No. 00 sandpaper and the last coat with a mixture of crude or machine oil and fine pumice stone powder. If you have a spraying outfit, spray on clear lacquer instead of shellac.

The second method is to buy bichromate of potash crystals and make a saturated solution in water. Dilute one part of the saturated solution with four parts water and stain the wood with it. When dry, rub lightly with No. 00 sandpaper. Next apply a coat of ready-mixed penetrating mahogany stain or wood dye. Then use the filler and shellac as before; or use filler, one coat of thin shellac, and two coats of varnish.

Maple may be finished to represent antique maple by several methods, one of the best being as follows: Apply one coat of the proper amber shade of water stain and proceed with the remaining part of the finishing as mentioned above for mahogany except that maple, being a very close-grained wood, will require no wood filling. The coat of shellac will fill any very small pores such as are found in maple. Another method is to give the entire chair a coat of oil walnut stain and when this is dry rub the high lights almost through to the bare wood with No. 00 sandpaper to give it a worn appearance. Shellac is then applied as in directions given before.

For imitating woods, apply a liberal brush coat of water stain, or a ready-prepared penetrating stain of the proper color and strength. Allow this to dry overnight; then apply a thin coat of white shellac and continue as directed above.

The upholstering can be done to suit the individual taste. A suggestion as to the method is given in Fig. 7.

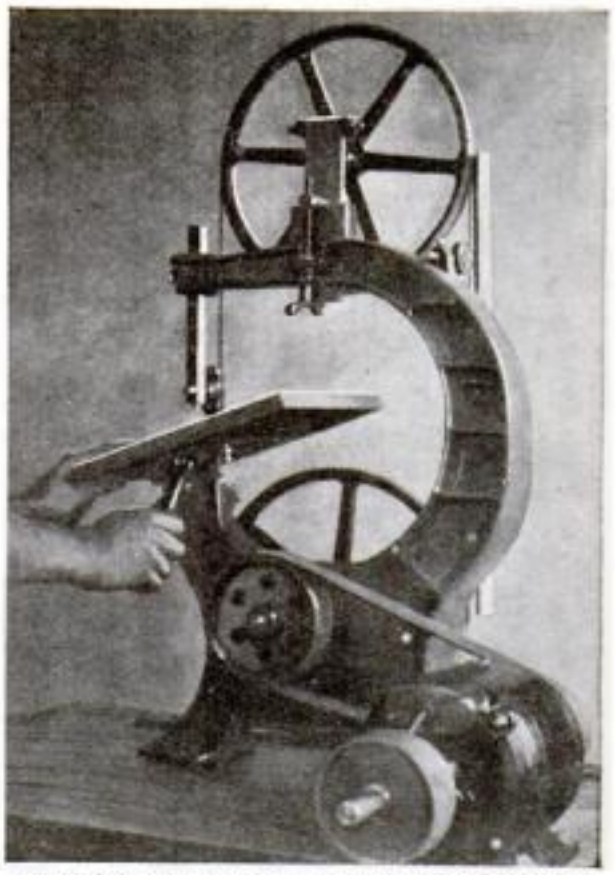

Fig. 6. The tables are adjustable to allow cuts to be made at any reasonable angle desired.

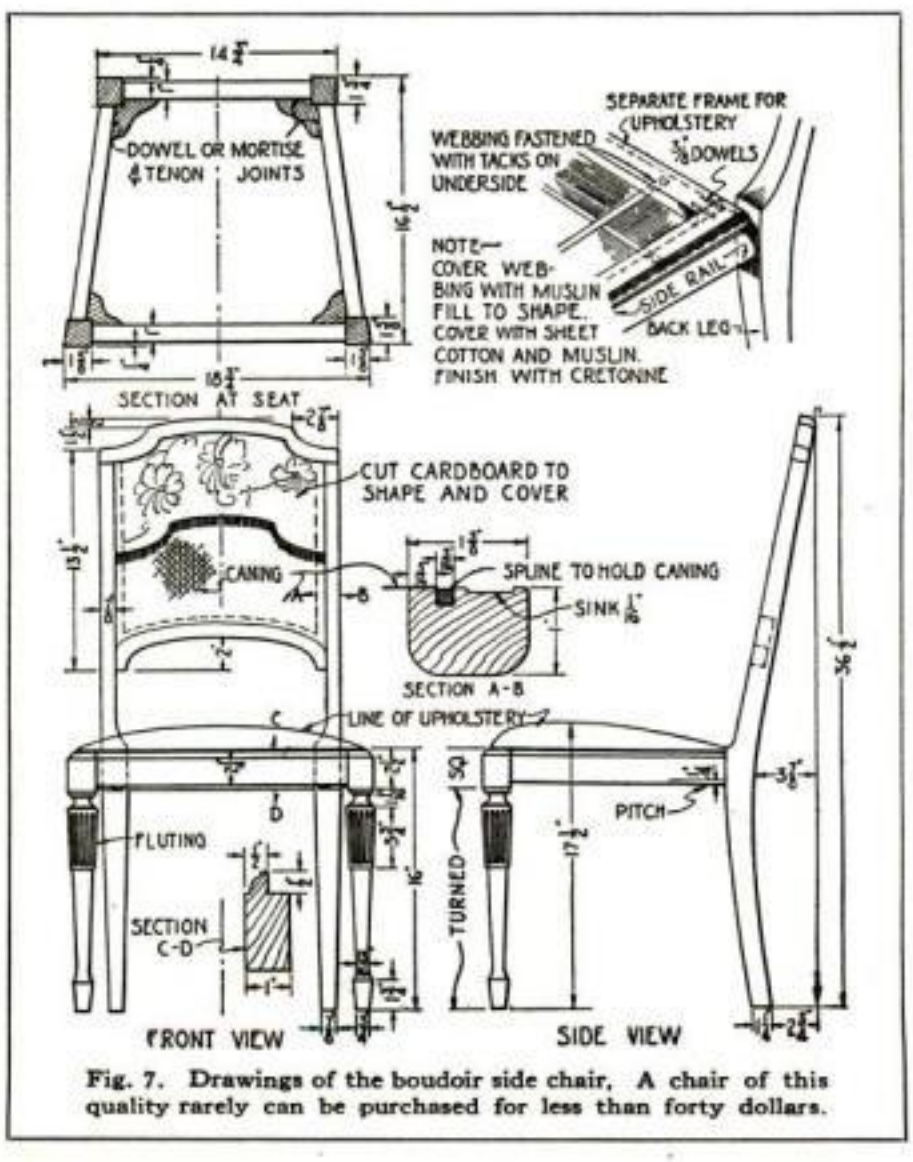

Fig. 7. Drawings of the boudoir side chair. A chair of this quality rarely can be purchased for less than forty dollars.

Removing Scratches

DEEP scratches that go clear through the finish on pieces of furniture can be removed if the right procedure is followed.

First, stain the wood in the scratch with a matching stain. Allow the stain to dry for about 24 hours, and then coat the scratch carefully with a first-class grade of furniture varnish.

After the varnish has been allowed to dry thoroughly, take an old razor blade and scrape off any excess varnish. Apply three or four applications of the varnish in this manner. Finally you will find that the varnish coats have built up until they are flush with the surface of the original finish.

The entire surface can then be rubbed down with a mixture of powdered pumice stone and oil.—FREDERICK J. PEASE.

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1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

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Timesaving Aids for the Shop

Use of Familiar Materials Simplifies Many Otherwise Difficult Shop Operations

By HENRY SIMON

A disk of hardwood can be used as a drill press pad or false drill table when no great amount of accuracy is required.

MONEY and time often can be saved in the machine shop through the use of familiar and inexpensive materials which are not ordinarily employed in routine operations. A number of short cuts of this type are illustrated.

Some odd jobs for paper, other than as a friction material, are illustrated in Fig. 1. By using the paper in the manner demonstrated at *A*, the clearance as well as the cutting ability of dies can be gaged before starting work, and troubles can be more readily analyzed than from the metal blank. A paper strip, applied as at *B*, helps to set gears to the desired clearance quickly.

Remember that as gears vary widely in pitch and face, paper also varies in thickness anywhere from .001 to .010 in. and more. Ordinary typewriter bond, about .004 in. thick, will be right for the average cases. The gears should be set up tight with the paper between them.

A quick, convenient way to clean the contact surfaces of a micrometer is to clamp an end of clean writing paper lightly between the gage surfaces as at *C*, and then pull it out. One or two thicknesses of thin, hard paper are a legitimate permanent makeshift for a metal bearing shim, at *D*, though this cannot be said of a layer as thick as at *E*.

A simple recipe for preventing spoilage in delicate hardened parts is that of removing the part from the quenching bath while it is still so hot that it makes water sizzle, wrapping it heavily in newspaper, and allowing it to cool slowly as shown at *F*.

No shop can get along without wood, but it can be used in many more ways and places than it generally is. Clothespins with the legs removed, as at *A*, Fig. 2, make excellent handles for small tools. The hardwood clamp at *B* is often a good substitute for the metal kind on lighter work. It is quickly made to any shape and provides its own friction, and is often the most efficient way of holding highly finished or soft metal work. As shown at *C*, hardwood and softwood of uniform grain made cheap, long-wearing, and noncutting shaft bearings that are very satisfactory at moderate speeds and bearing pressures. There is nothing that can take the place of the old-fashioned wooden mallet at *D* for setting tools and other parts.

On some machines, wooden links or connecting rods like those at *A*, Fig. 3, are not only strong enough for the work required, but have the added advantages of being lighter, more easily shaped, and more shock absorbing than most metals.

How to make and set bearing sleeves that will be tight in such wooden links is shown at *B*. The sleeve is threaded outside, slotted like a screw, and driven home while the wood is held moderately compressed in a vise. Close-grained hardwood is suitable for permanent stepped cone pulleys and for small handwheels on light drives, as suggested at *C*. Such pulleys and wheels are cheap and quickly made. A hardwood disk or false table serves as an excellent pad for use on a drill press in work requiring no high degree of accuracy, as shown in illustration at the top of page 92.

In Fig. 4 are shown three friends and brothers—babbitt, lead, and solder. An emergency cross slide nut, like that at *A*, which was poured right in place, was used on a lathe in the writer's shop for a full year and it gave excellent service. In the same manner, babbitt may be used in experimental work for making temporary nuts or entire parts containing female threads.

A plan for floating and holding an auxiliary punch in a set of die tools in babbitt is shown at *B*. The screw only holds the punch from pulling out, but the babbitt prevents it from creeping, and does not prevent its being easily reset at any time.

The lead hammer at *C* is a good team mate for the wooden mallet, especially if it is recast occasionally to keep the form somewhat like that shown. A lead plug, which may be poured to any shape and right in the place desired, can be made, with enough pressure, to flow around a corner or in several directions in the manner indicated at *D*.

The old joke about the "putting-on-tool" can be turned into reality by putting solder on parts that are over or under size. Where two parts fail to fit and are not required to move relatively to each other, as at *A*, in Fig. 5, solder often offers a practical solution. One part is coated with solder and the other sheared into it. Of course it is necessary that neither of the parts be so frail that they

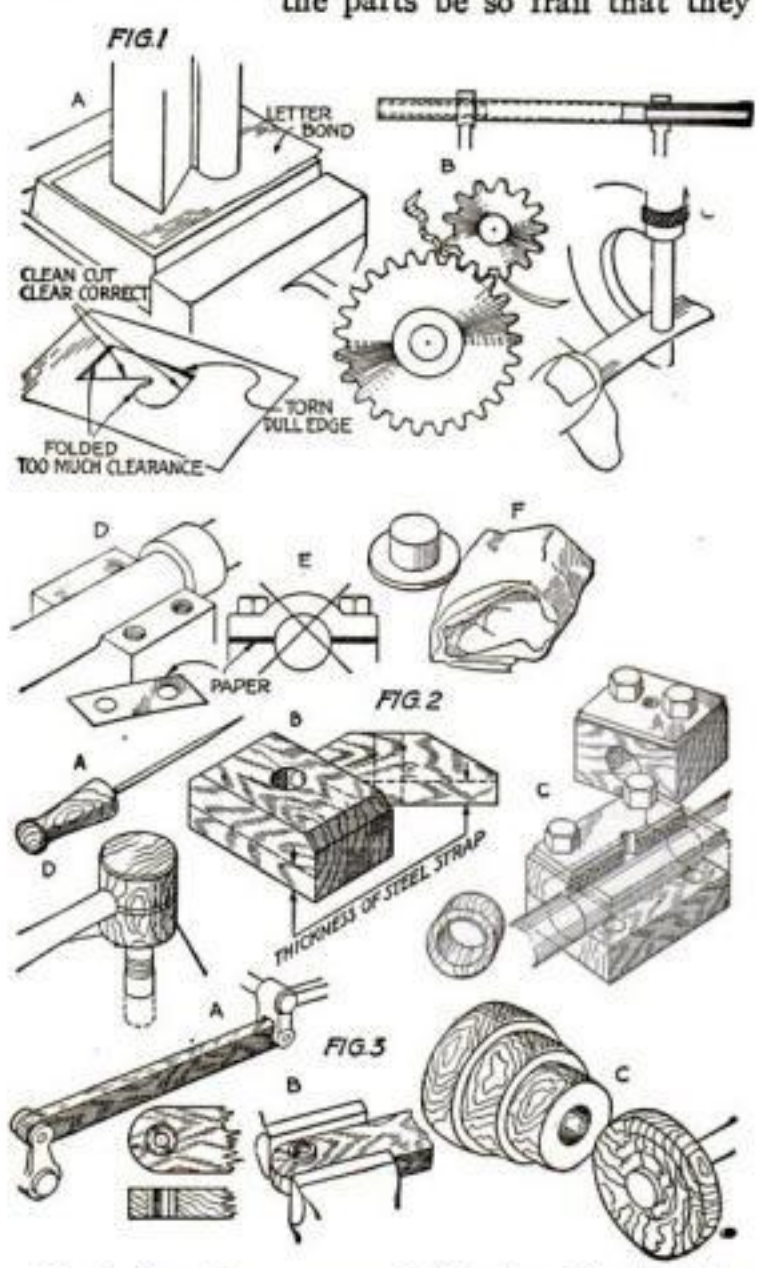
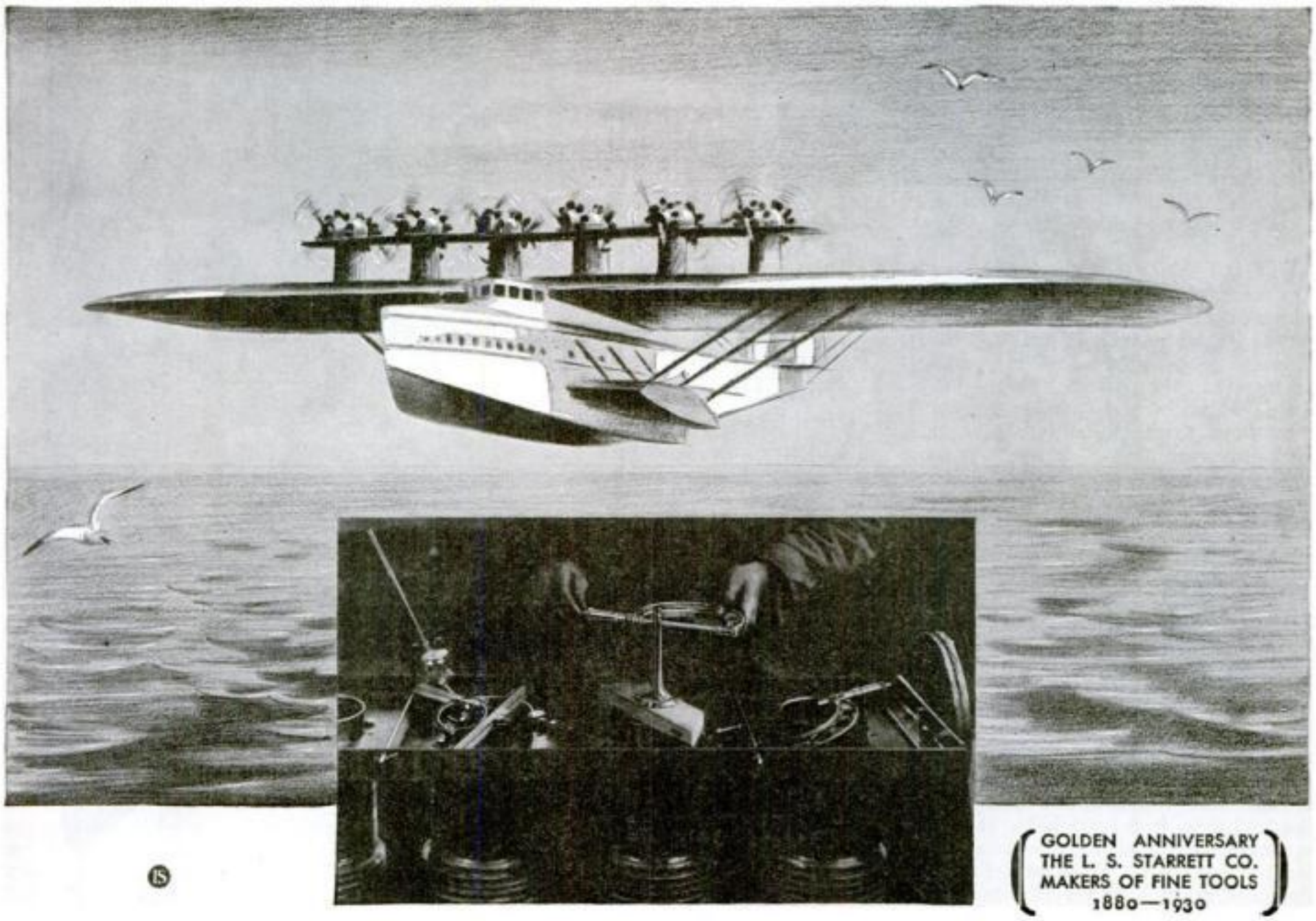


Fig. 1. Paper has many uses in the shop. Fig. 2. A few odd uses for wood. Fig. 3. Machine parts made of wood.



GOLDEN ANNIVERSARY
THE L. S. STARRETT CO.
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1880—1930

A yacht takes wing

The air quakes with the phasing beats of twelve propellers . . . a roaring yacht lifts from the sea, takes wing.

A triumph of engineering skill? Yes . . . and a triumph of craftsmanship, a triumph of skilled hands and precision tools.

Real craftsmen the world over do their best work with the tools that offer them the most precise accuracy—with Starrett Tools. Whether you use fine tools in your serious work or as a hobby, your hands will borrow greater skill from the unfailing accuracy of Starrett Tools.

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would be likely to be distorted or cracked in the process.

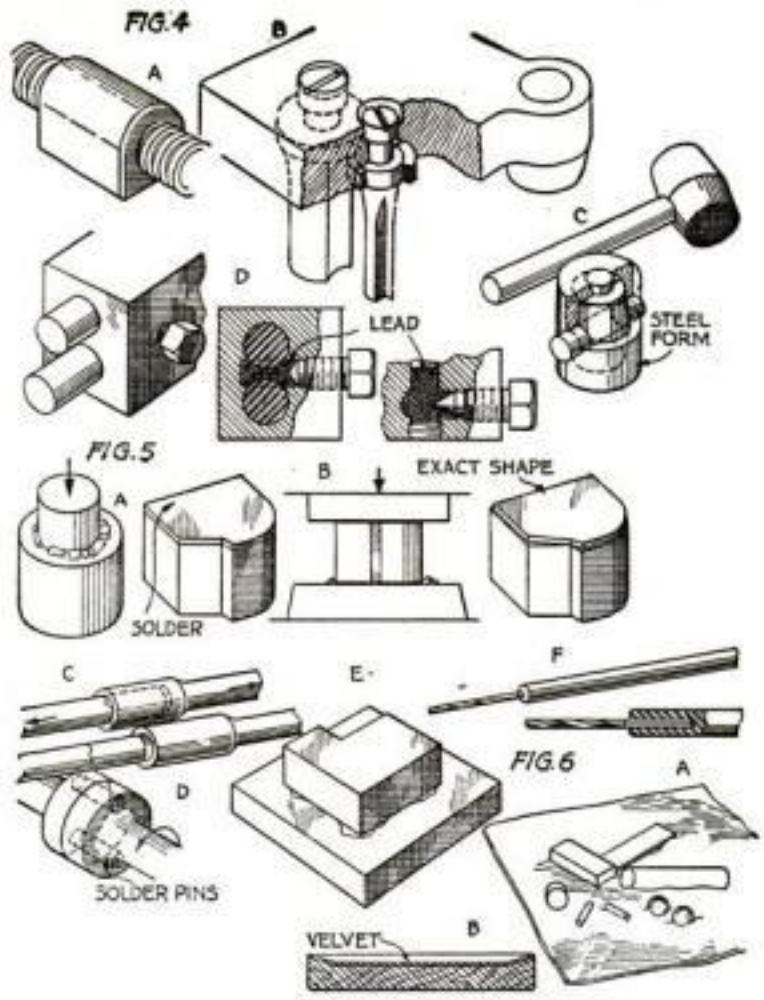
For those who are not acquainted with it, a die maker's use of solder is illustrated at *B*. By coating the end of the rough-formed punch with solder to a depth of from 1/16 to 1/8 in. and forcing the punch into the die under a screw press, the exact profile is clearly formed in the solder, and it is then an easy matter to work to this form.

WHILE solder should ordinarily not be used on parts that get very hot because it melts, that very quality can be turned to advantage in making fusing connections, as in the case where a drive is to stop when the parts get heated. Two simple forms are shown at *C* and *D*. Sometimes, the best way to mount small work for machining is to sweat it on a plate which can in turn be adjusted and held on the faceplate, as at *E*. In this way, the work is under practically no compression or tension, and all surfaces except the bottom are easily accessible.

One of the best ways of holding delicate drills for use in a screw machine and elsewhere is in a solder chuck, consisting of a piece of small rod as at *F* with a free-fit hole for the drill. This may be made to any length to give the required reach, and allows the drill to be floated by merely bending the rod slightly.

Even cloth has its uses in the shop. Though velvet is used for lining every fine tool case, it is remarkable that it is not more often made to serve as a resting pad for fine tools. As a matter of fact, a piece of heavy dark velvet like that at *A* in Fig. 6 is the one perfect bed for small tools and delicate parts. They do not roll or slide about on it, are always easily seen, and the cutting edges as well as the fine finish are saved from damage. Better in some ways than the bare cloth is a wooden disk, either dished or plain, as at *B* and *C*, with the velvet glued in place as a lining.

This is the thirteenth in a series of articles by Mr. Simon on shop problems of interest to machinist and toolmaker. In his next article, which is scheduled for early publication, he discusses the use of wire in the shop and shows how many operations can be simplified through its use.



Figs. 4 and 5. Babbitt, lead, and solder simplify many operations. Fig. 6. Heavy, dark velvet forms a bed for tools.

Electric Muffle Made from Heating Unit

AN EFFICIENT electric muffle for heat treating metals in the home workshop can be made from the common reflector type of portable electric heater designed for household use.

This type of heater has the resistance wire wound on a porcelain tube. When in use the tube becomes red-hot and is the correct temperature for hardening and tempering steel.

The tools to be treated are slipped inside the tube and heated to whatever temperature is desired without any danger of burning them or depositing a heavy coating of scale on their outer surfaces, both of which difficulties are likely to occur when a gas or coal stove is used in hardening and tempering operations.

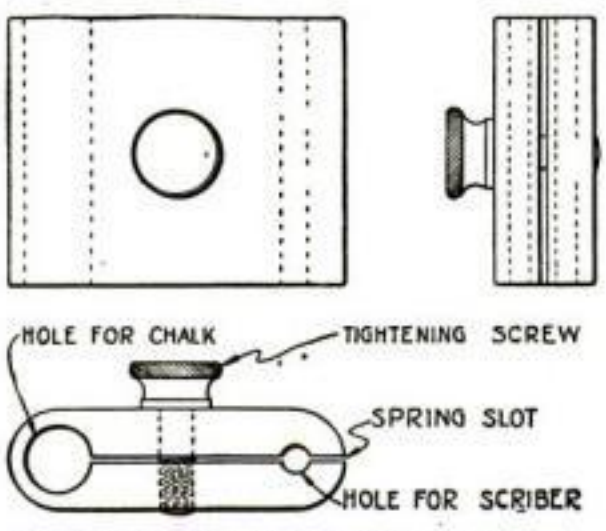
If so desired, one of these resistance units can be mounted on a metal stand and can be placed as a permanent fixture on the workbench.—S. BINGHAM HOOD.

Chalk Holder Aids in Accurate Scribing

EVERY mechanic knows that in marking work a much larger surface is usually chalked than is necessary because the exact position is not known until the surface gage is used.

With the chalk holder shown, the chalk marks the exact place that the scriber will follow and thus no time is wasted.

The clamp is made from bakelite and drilled to receive the chalk and scriber of the gage. Cut a slot through on the edge having the scriber hole and drill and tap a hole in the center of the piece to receive the tightening screw. The corners of the holder can be rounded or left square as desired.



The holder, which can be made in any convenient size, fastens on the scriber of the gage.

The chalk mark is made at just the right height to be in line with the scriber point.

Slip the holder on the scriber, which is held in the surface gage, and then put the chalk in place. Tighten the screw, being careful to see that the holder is in a horizontal position. The combination scriber and chalker is now ready for use on the surface plate.—H. MOORE.

Old Bill Says—

IF YOU remove the center from the headstock of your lathe for any reason, plug the hole with a piece of clean waste to keep the dirt out.

A flat drill will often drill hard, tough materials better than a twist drill.

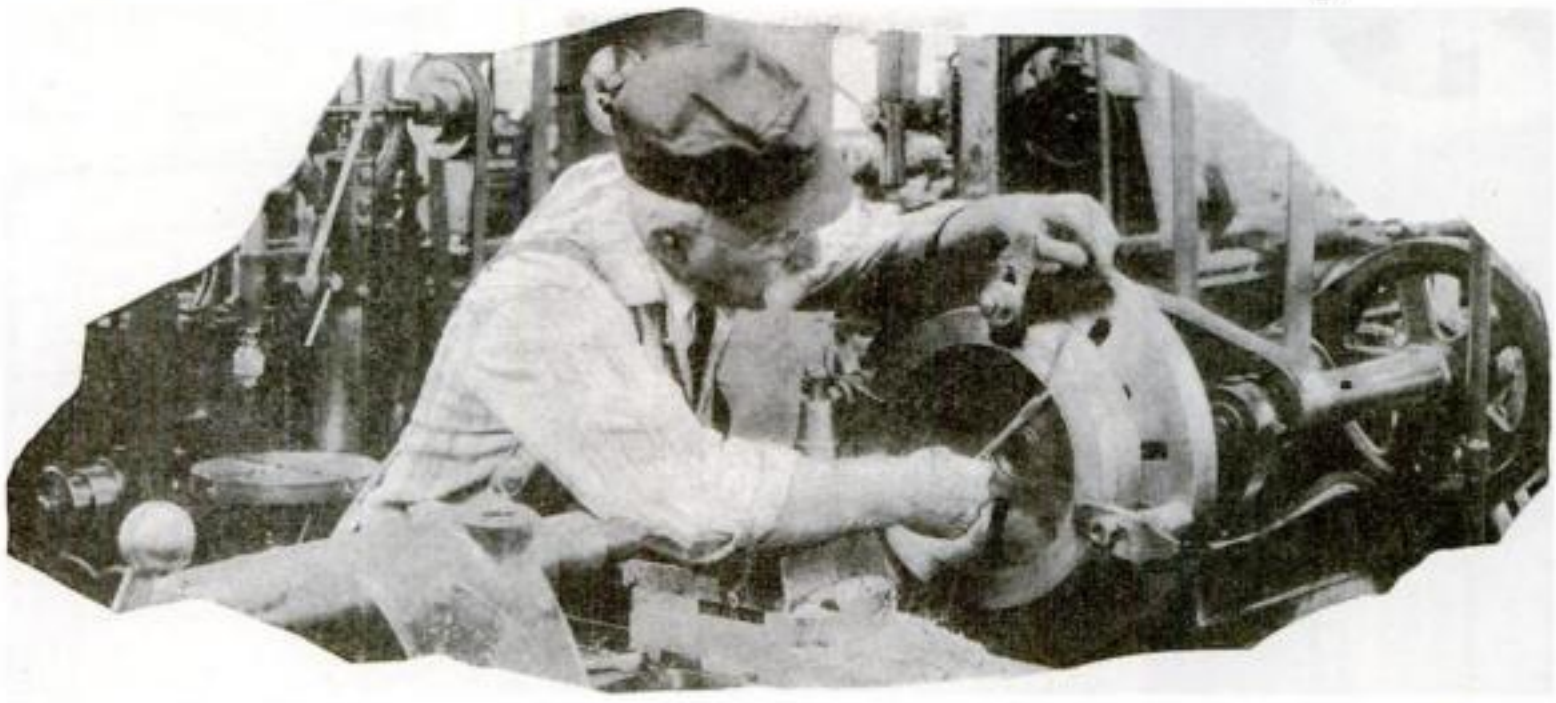
When a drill squeaks in the hole, it is usually a sign that the side clearance has worn away. Trying to force the drill under this condition may break it.

Carbon tool steel proves superior to high-speed steel in many cases for putting a good finish on work.

Back gears are to be used for two principal purposes—when more power is needed to pull a heavy cut, or when the speed must be reduced to cut exceptionally hard or tough materials.

A leather belt should always be run with the hair or grain side toward the pulley, because the belt is less apt to crack, will last longer, and will transmit more power.

Inside Measurements—any size

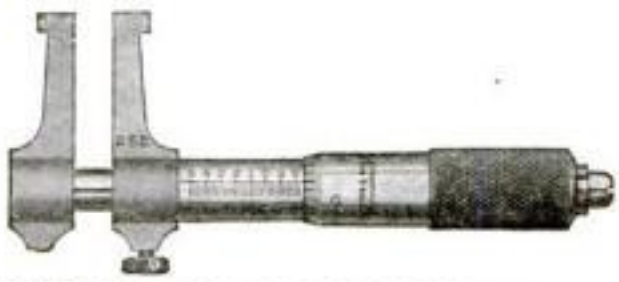


Quickly—Easily—Accurately

For measuring inside diameters of rings, cylinders, holes, widths of slots, recesses—anywhere that inside dimensions are required — there is a Brown & Sharpe Tool which will measure accurately and quickly. Here are some of the tools universally used by skilled mechanics.

INSIDE MICROMETER CALIPER NO. 250

With a range .200" to 1" by thousandths of an inch, this micrometer is especially adapted for accurately measuring small internal dimensions.



INSIDE MICROMETER CALIPER NO. 252

Shape of the jaws makes it possible to take inside measurements over a flange or shoulder. Range ½" to 1½" by thousandths of an inch.

TELESCOPING GAUGES NO. 590

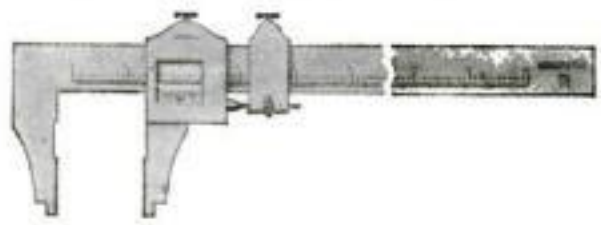
Designed to be used with a Micrometer Caliper to determine quickly internal measurements. Telescoping head expands to full size of hole or slot to be measured and is then locked by turn of knurled screw in end of handle. Range ½" to 6" is secured by using five interchangeable heads.

INSIDE MICROMETER NO. 264

With a range 2" to 8" by thousandths of an inch, this is truly a versatile tool for inside measuring. Clamp nut—an exclusive Brown & Sharpe feature—preserves the setting.

TUBULAR INSIDE MICROMETERS NO. 276

Takes long inside measurements by thousandths of an inch. There are three separate tools, with changeable anvils having a combined range of from 12" to 42". They are light, accurate tools, easy to handle.



VERNIER CALIPERS NO. 570

A versatile tool for both inside and outside measuring by thousandths of an inch. Graduated on one side for inside, and on other side for outside measurements, thus simplifying the reading. Made in four sizes: 6", 12", 24" and 36".

Other Brown & Sharpe Tools for inside measuring include: Thickness Gauges, Rules, Inside Calipers, Indicators, Vernier Height Gauges, Depth Gauges. All these tools are described in our Small Tool Catalog No. 31 which includes over 2300 useful tools. Send for a copy. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

Brown & Sharpe Tools

"WORLD'S STANDARD OF ACCURACY"

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Copying an Antique Low Boy

By
F. J. BRYANT

A handmade low boy such as shown could not be purchased for much less than one hundred dollars.

WOODWORKERS often like to try their hand at copying a fine specimen of antique furniture—such a piece, for example, as the low boy illustrated. The original, which was made about 1740, is noteworthy for its grace, and because of its limited size would look as well in a small as in a large room.

The legs are taken from what is known as the "cabriole" design, which places the low boy in the Queen Anne period.

Walnut is the wood of the original, but either maple or mahogany can be used, if desired, in building a reproduction. The backs, bottoms, guides, runs, and sides of the drawers are of white pine.

Mortise and tenon joints are used for the back and ends, the tenons being 3/8 in. thick and 3/4 in. long. On the back and end boards, the tenons are made the full width of the stock, 12 1/4 in. The back, the ends, and the rails and stiles on the front are made flush with the legs. Small visible dovetails are shown where the front rails and stiles join together.

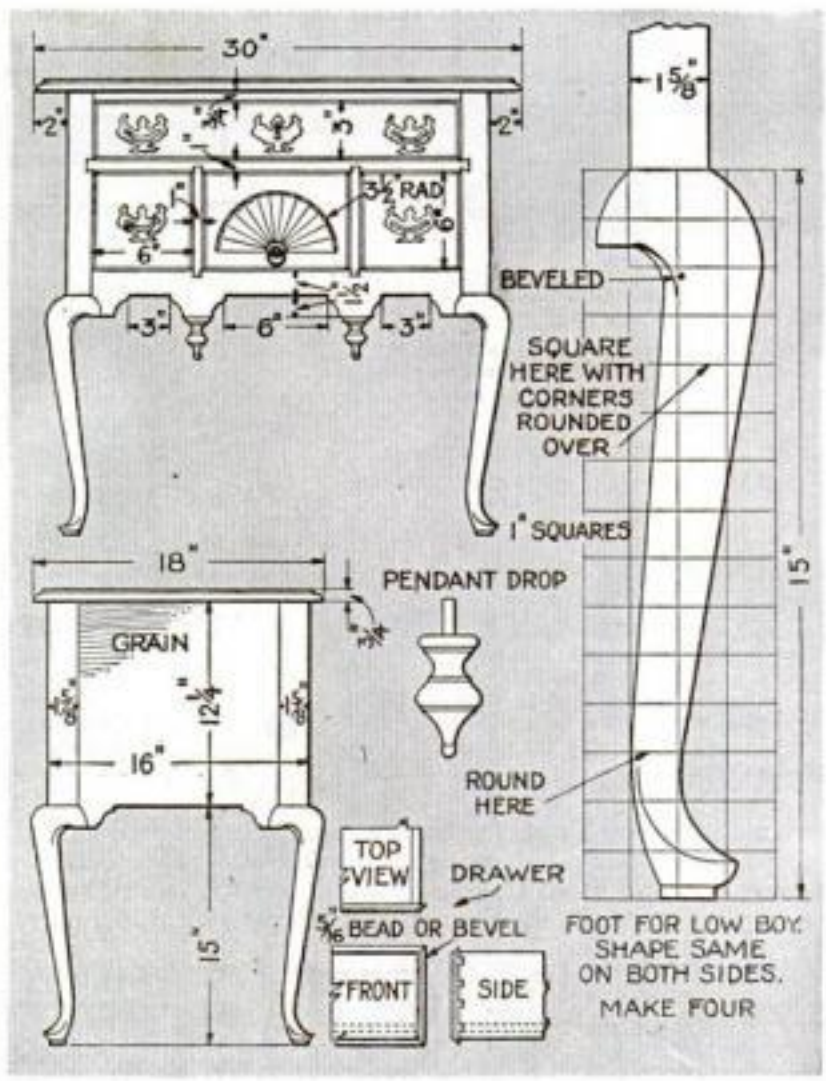
In making the legs lay out the shape by ruling off a number of 1-in. squares on wall board or stiff cardboard, draw the outline, and cut a pattern. Place this on one side of the stock and trace the outline on the wood. Do this on an adjoining side or surface, turning the pattern over. The piece is now ready for band sawing. Follow the pencil line closely and cut out the entire piece.

Tack or glue the waste pieces lightly back in position, turn the leg over, and repeat the cutting of the leg on the other side. In other words, use the cutaway stock for a cradle while making the second cut. All four legs are fashioned this way. All that remains is to spokeshave the legs from a rounded shape near the base to an almost square shape near the top.

If walnut is used, an oil stain may be applied and followed with a wash coat of shellac, a filler, and two coats of varnish. Oil rubbing is another desirable method of finishing, but it takes longer and requires a number of coats. Mahogany can be treated the same way; maple, however, should be left in the natural color.

For the drawer handles select reproductions of a Chippendale design in dull antique brass finish. A self-addressed envelope sent to the Information Department of POPULAR SCIENCE MONTHLY will bring the name of a manufacturer who stocks an exact copy of the handles illustrated.

Those who wish a complete list of materials and additional hints on the construction should send a self-addressed and stamped envelope with a request for Home Workshop Bulletin No. 3.



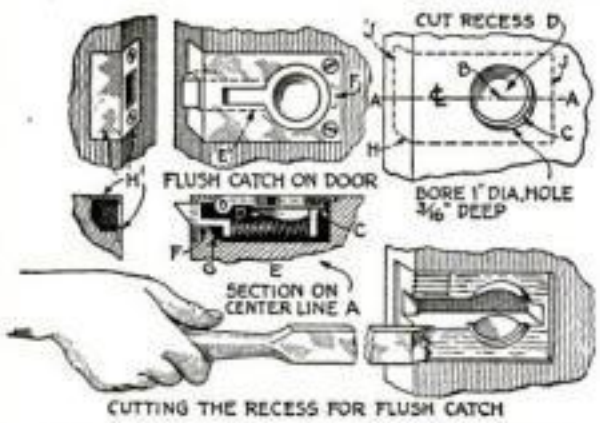
An itemized cutting list and additional information can be obtained by sending a stamped envelope for Home Workshop Bulletin No. 3.

How to Fit a Flush Ring Door Catch

WHEN the projecting case and knob of an ordinary cupboard catch or latch is objectionable, the handy man will find tucked away upon the shelves of the nearest large hardware store just the substitute he needs—a flush ring catch.

A flush catch leaves the face of the door and of the bookcase, cupboard, or chest of drawers with no projection to mar its smoothness. The catch purchased may be different in size and shape from the one illustrated, but usually its mechanism and the method of attachment are similar.

In fitting this particular catch, locate the center line *A* and on it the center of the ring socket *B*, which is 1⅜ in. from



CUTTING THE RECESS FOR FLUSH CATCH

The design of the catch may vary slightly, but the method of fitting will be the same.

the front corner of the faceplate. Bore a 1-in. hole about 3/16 in. deep to receive chamber *C*. With a gouge or narrow chisel, finish the circular recess *D* to receive the dome-shaped casing of the finger hole. Cut a 3/8-in. groove *E* back to the ring socket and a 1/4-in. groove *F* nearly to the back of the faceplate to allow the back end of the latch plenty of room. The groove *E-F* should be 5/8 in. deep but stopped at the front so it will be not more than 3/8 in. from the face of the door, as indicated at *G*.

Fit the plate by laying the latch in the recess and marking lines *H* carefully with a sharp knife point. Also mark lines *J* accurately with a gage, for the neatness with which the face and edge plates are fitted depends much upon these lines. The plate recesses should be just the depth to allow the faces of the plates to rest exactly flush with the face of the door.

Make the first cut of the chisel a trifle away from the line, then cut back to the line. Trim to depth, holding the chisel carefully as shown.

Fasten the catch in place with screws, being sure the latch works freely. Close the door and mark the location of the latch upon the door frame. Mark plate lines *H'* of the striker plate and cut out the plate recess. Fasten the plate with screws and chisel a recess to allow the latch to enter easily.—C. A. K.

SLOW-DRYING or "tacky" paint, as it is generally termed, may be caused by a number of things. One of the most frequent, however, is the use of adulterated linseed oil, kerosene, fish oil, rosin oil, mineral oils, or other nondrying oils in the paint instead of, or in addition to, the pure linseed oil.

Embossed Leather Decorates Metal Paper Knife

By F. CLARKE HUGHES

This leather embellished letter knife lends a note of decoration to the entire desk top.

BY INCASING its handle in embossed leather, a plain paper knife can be converted into an attractive ornament for any desk, as shown at the right. The embossed design is similar to one used in making the leather book ends previously described in this series (P.S.M., Jan. '30, p. 100).

Leather is a most satisfactory and durable material for craft work, and with this new and easy method of embossing, many designs can be developed.

The materials needed are: a piece of stiff metal for the blade, brass, copper, or steel being the best suited; two pieces of leather, preferably tooling calf for the handle; a scrap piece of leather for the lacing, linoleum for the die, felt for the pads, and two wooden blocks to be used in the pressing or embossing operations. If desired, sheet celluloid can be used for the blade.

The best way to cut the pattern is to fold a long narrow piece of paper in the middle as shown in the illustration at the bottom of the page and make a free-hand cut with the scissors. Many novel and original designs can be made in this way. However, the general shape should conform more or less closely to the drawing insofar as the narrow neck is concerned because this serves as a means of retaining the leather on the handle.

In cutting the blade a number of the more common of the tools to be found about the ordinary home shop may prove useful. A pair of tin snips, a small cold chisel, or a small jeweler's saw will doubtless be the best to use for this shaping, but it will be a problem for the individual craftsman to work out for himself, making use of the tools which are available to him. The burrs around the edges may be taken off with a file or a small grinder.

The leather handle should be cut as shown so that the outside line is ⅛ in. larger all around than the body of the blade. The leather may be either the regular commercial "tooling calf" or salvaged from an old shoe or slipper.

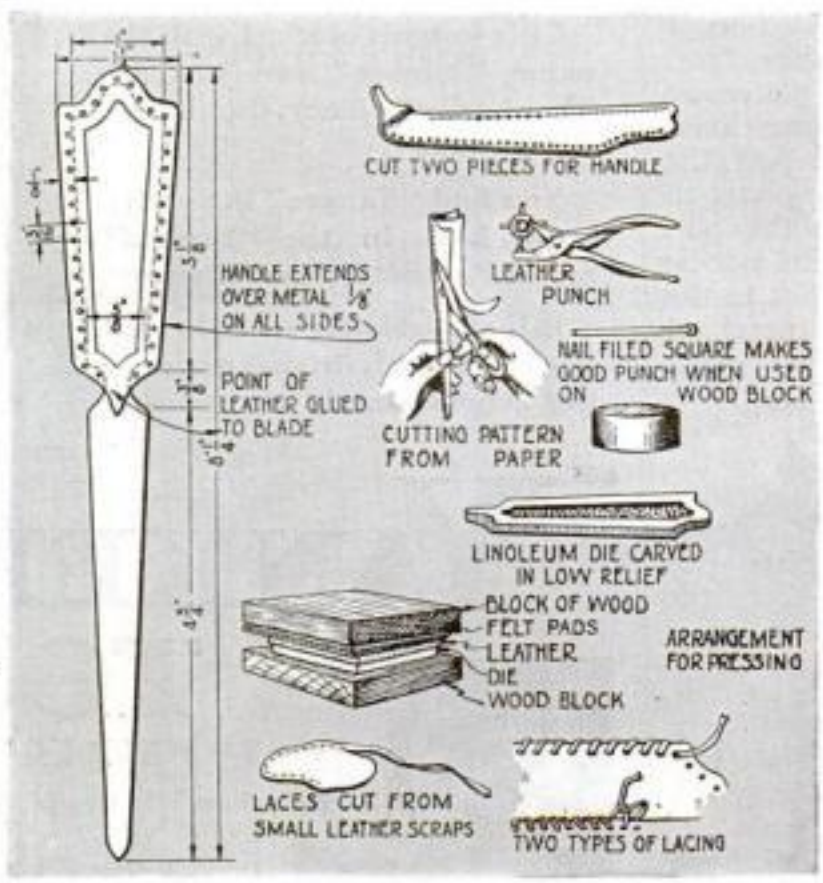
The die used in the embossing operation is made by cutting a piece of battleship linoleum to the shape and design desired (see drawing at the bottom of the page). Wet the leather thoroughly before placing it against the die.

Place the leather, die, felt pads, and blocks in a vise or old letterpress, if one is available, and apply the pressure. Remove the leather before it is dry or it will stick to the die.

The holes for the lacing can be made with an ordinary leather punch or, if none is available, with a nail filed flat at the end. These holes should be placed 3/16 in. apart and ⅛ in. in from the edge of the leather.

A thin black leather such as kid or kangaroo skin is the best to use for the lacing and may be obtained by cutting from a small round piece taken from a glove or slipper. A plain over and over type of lacing is used.

After the edges have been laced and all of the loose ends and rough places smoothed and polished, it is well to shellac the edges and polish the whole with a little shoe dressing or floor wax.



Dimensions of the knife, cutting the pattern, punching the holes, how the lace is cut, the linoleum die, and the types of lacing.

Blueprints for Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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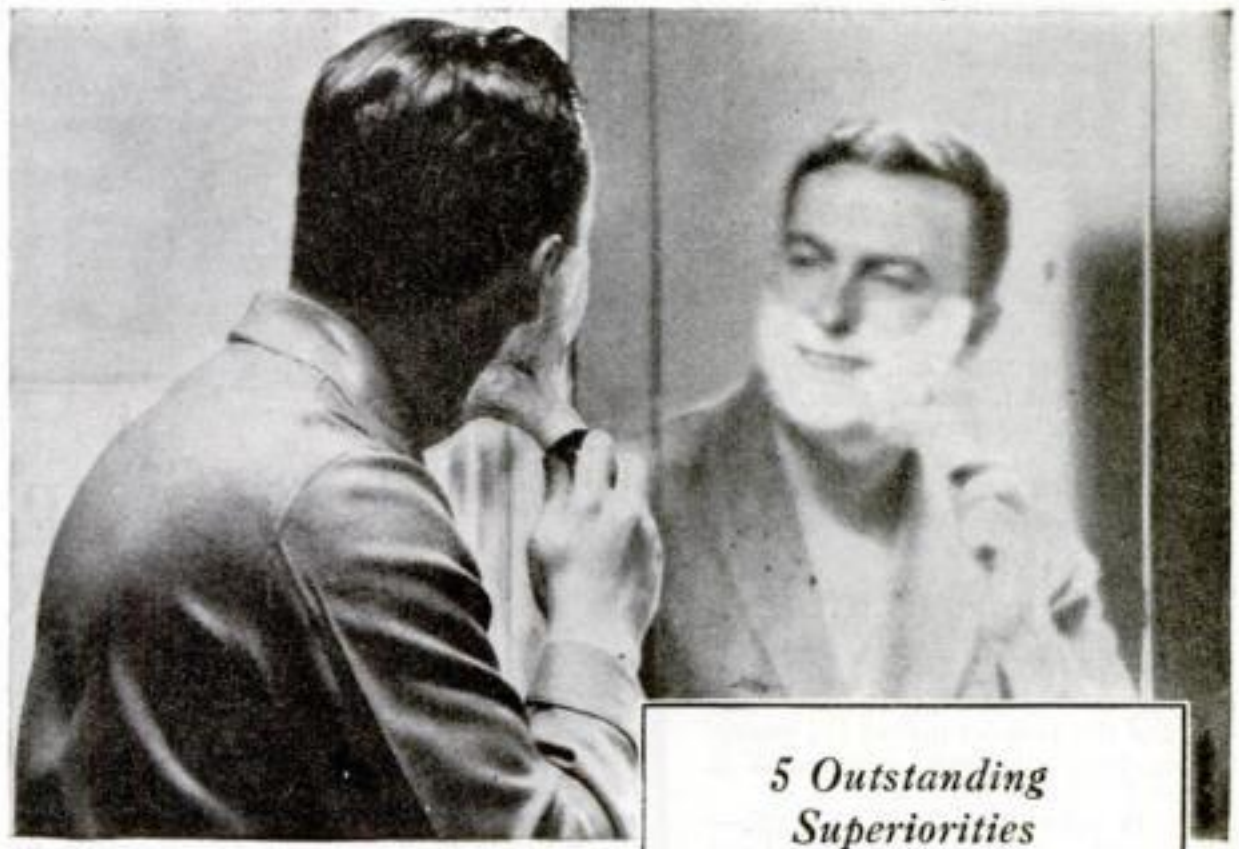

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The set includes a table and chairs, all fashioned after the true Swiss furniture construction.

Simplicity attained with no loss of beauty is the outstanding feature in this design.

Building Simple Swiss Pattern Furniture

By HI SIBLEY

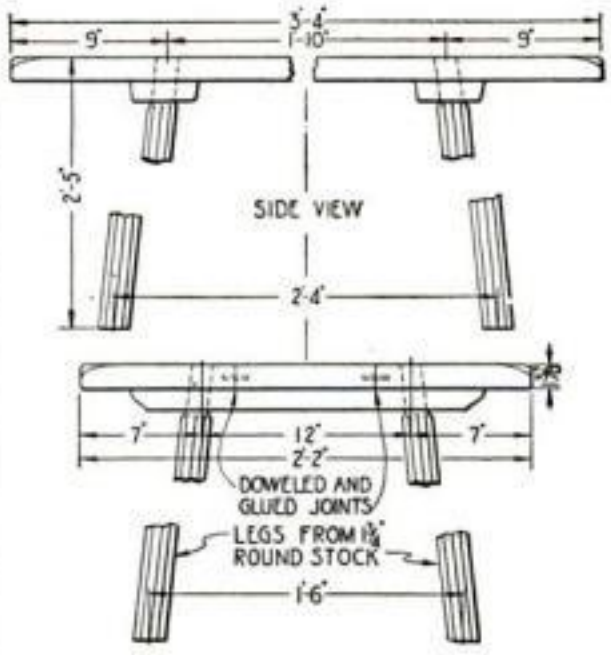
FOR simplicity of construction and general adaptability, the Swiss breakfast set illustrated probably has few equals. The table and chairs, which are an exact copy of original Swiss furniture, are the handiwork of Fred Hauser, of Pasadena, Calif.

Each piece can be turned out readily in the home workshop, since no lathe work is required. While a band saw will come in handy for cutting the chair backs, a coping or keyhole saw can be used. Mr. Hauser fashioned the set from gumwood, but other woods will serve the purpose.

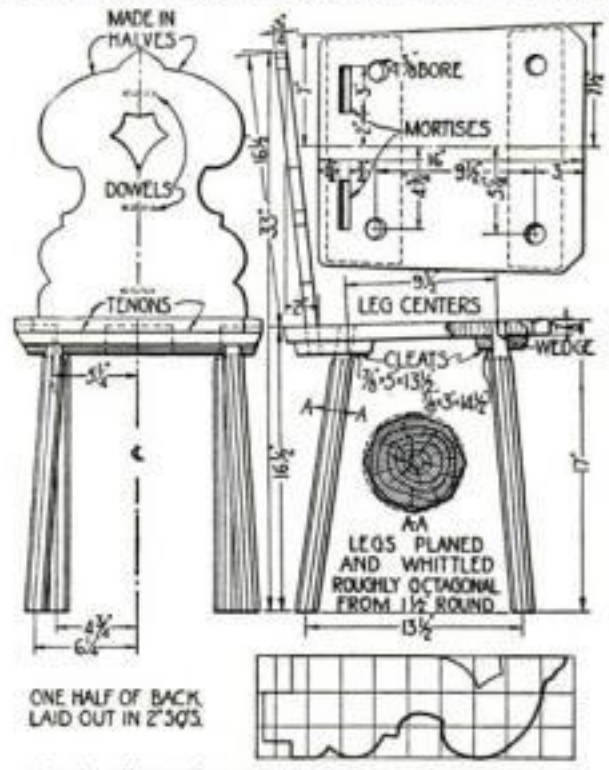
In making a chair, the seat is first cut from ⅞-in. lumber, two pieces being doweled and glued together if necessary. Chisel two mortises to receive the back rest tenons; then screw the crosspieces or cleats on the underside. Locate the centers of the holes for the legs, and bore them at the suggested angles.

Note that the ends of the legs come flush with the top of the seat. While this is contrary to conventional practice, it is according to true Swiss furniture design. A thin hardwood wedge driven in the top of each leg at right angles to the seat grain insures a firm joint.

Plane the legs roughly octagonal and finish them with a jackknife or spokeshave. Round the upper ends to fit snugly in the seat holes, and drive in the wedges, smoothing the top surface with sandpaper. Make tool marks in the top of the seat with a chisel or broad gouge to give the effect of hand-hewn lumber.



The table top is made in three sections, and wooden cleats are used instead of the usual rails.



Chair dimensions and pattern for the back, which is made in halves and glued and doweled.

For the cleats, choose a tough wood and screw them to the bottom of the seat in such a manner that they are not likely to split when the wedges are driven into the tenons of the back. Oak is not a particularly good material for the cleats, since it splits too readily.

The back rest is made in halves, cut according to the diagram and held together with dowels and glue. After the dowels are inserted, but before gluing or

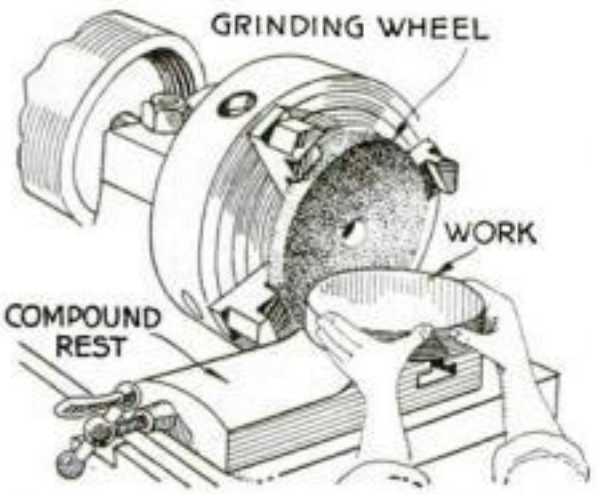
sawing the outlines, plane the surface so that the finished joint will not be evident. In gluing this joint, as well as all others, clamp the parts together tightly while the glue is drying. Next drive the tenons into the mortises and tighten with wedges similar to those used in the legs.

While very substantial, the table is about as simple a one as can be made, consisting simply of a top, two cross-cleats, and four legs. Build the top from three 1⅜-in. finished planks, fitting them together with dowels and glue, and screwing on the cleats. To give the appearance of having been worn by scrubbing for many generations, the corners are tapered off with a plane, rasp, and sandpaper.

The table legs are attached in the same manner as those on the chair, but are slightly heavier.

The finish is a matter of individual taste. The originals were stained with walnut stain, sandpapered, stained again, and the surface hand-buffed with a coarse cloth to a dull luster.

Using a Small Grinding Wheel in the Lathe



The wheel is held in a chuck, and the compound rest is used as a table for guiding the work.

WHEN it is necessary to grind an oval form—as for flanging some light tank heads—a machinist in a small shop is likely to be at a loss as to how best to get the outline true without undue expense.

A unique method is to chuck a grinding wheel in a lathe and use the compound rest as a work support. In this way, the line to be followed is in clear sight, and the work is at all times square with the side of the wheel. This application of the wheel will allow a lathe to serve in an emergency as a surface grinder in small shops.—ALBERT E. BIRD.

How to Remove Cement and Plaster from Tiles

TO REMOVE cement and plaster from tile floors, first scrape off as much as possible and then apply muriatic acid in the proportions of one part acid to ten parts water. Add the acid slowly and cautiously to the water and handle the mixture with care.

Rub the marks with a rubbing stone or an oilstone such as is used for sharpening tools. The oil with which the oilstone is impregnated will have no effect on the tiles. Work quickly, do not allow the acid to remain too long, and wash it off very thoroughly.

Painting model railway cars is an operation that, if carried out carefully, does much to add to the realism of the entire system.

Painting Model Railroads

By F. D. RYDER, JR.

HIGH-GRADE model railway locomotives and the various cars are painted by a dipping process, and the enamel is baked on to give an attractive and durable finish. Repainting is, however, often necessary. Cars will become derailed and collisions will occur even on the best regulated model railway, so that the enamel in time becomes chipped and scratched. Then, too, the color scheme, even when the equipment is new, may not be what is desired for the system.

Brushing lacquer is by all odds the most convenient material with which to change the color scheme of new additions to the rolling stock or to do a refinishing job. In particular, the brushing lacquer designated as auto and metal surfacer is ideal for painting the nickel wheels on model railway rolling stock. It covers perfectly with one coat and the color—a dark, rusty brown—is most realistic.

There are three essentials to success in painting locomotives and car bodies. The first is the use of at least two coats of lacquer to which extra solvent has been added to make it somewhat thinner than normal. The second is to use small brushes of either badger or camel's hair. The third is patience in liberal quantities.

I have spent as much as five hours in painting one model locomotive, including the time used in painstakingly going over the handrails and other trimmings.

Have all surfaces clean, smooth, and absolutely free from oil before you start. Remove the body while you paint it if it is to be a different color than the frame. Remove the motors of locomotives and the trucks of passenger cars during the wheel-painting operation.

The solvent in brushing lacquer quickly softens the original baked-on enamel finish. The first coat must, therefore, be applied smoothly without going back over spots that have once been covered, to avoid having the original color striking through the color you are applying.

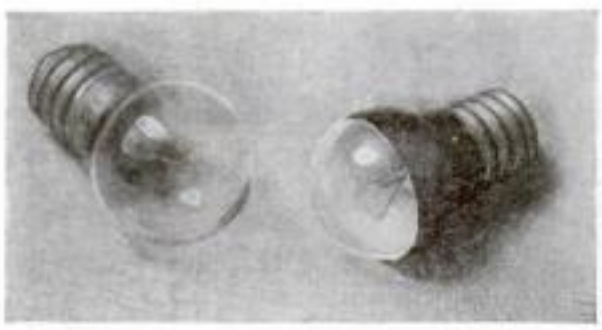
Before tackling a locomotive or passenger car, perfect your technique on a tin cracker box or tin can.

A coat of undercoater white lacquer applied to the underside of the roofs of the passenger cars will noticeably increase the brightness of the lighting.

The judicious use of brushing lacquer will greatly improve the effectiveness of the headlights on the locomotive. As ordinarily used the headlights scatter light in every direction. Headlights on real locomotives do not do this.

A solution of the difficulty is to make the rear portion of the bulb act as a reflector. Holding the bulb by the base, dip the glass portion in a can of white brushing lacquer. Allow it to dry for at least an hour. Then give it another quick dip. Let the second coat dry at least two hours and give it another quick dip, this time in black lacquer or a color that will match the body of the headlight. After this treatment, the bulb should be left to dry for a day and then, with a penknife, mark a ring around the bulb just in front of the center line. Carefully scrape off the front portion of the lacquer coatings.

The two coats of white lacquer left on the portion of the glass next the base reflect a goodly portion of the light forward. The black outer coat cuts off the light that penetrates the white lacquer so that no light is projected backward.



By painting the backs of the headlight bulbs, you can gain the same effect as a reflector.

If the base of the bulb is first poked into a hole in the cardboard box in which you received it, the successive dippings can be done without risk of rubbing the lacquer off the glass. The box will also serve to hold them while they dry.

Assembling Miller Cutters for Use on Large Work

IN ORDER to accomplish some milling operations it is often well to use extra wide cutters. A method for interlocking two or more cutters is shown.

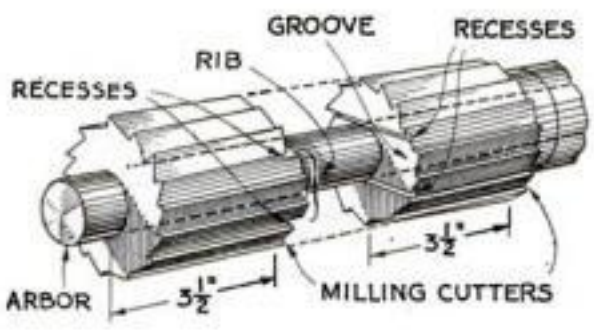
The greater part of the work is done on the surface grinder. In cutter No. 1 cut two parallel slots 3/32 in. deep, using a 6-in. medium grade elastic grinding wheel 1/8 in. wide. Remove the wheel and replace it with a 6 by 1/4 in. alundum grinder. With this grind recesses *A* and *C* to a depth of 1/16-in.

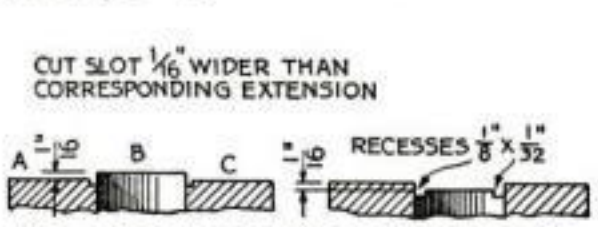
Coat the cutter with a fairly heavy application of Prussian blue and place it on the arbor with cutter No. 2. In this way the location of the slot in No. 2 can be ascertained.

Repeat the grinder operation on cutter No. 2, making the slot 1/64 in. wider than the corresponding extension on No. 1.

The cutters can then be ground down to the same size radially.

By using a variation of this system it can be applied to gang type cutters of varying diameters.—H. CHAMBERLAND.

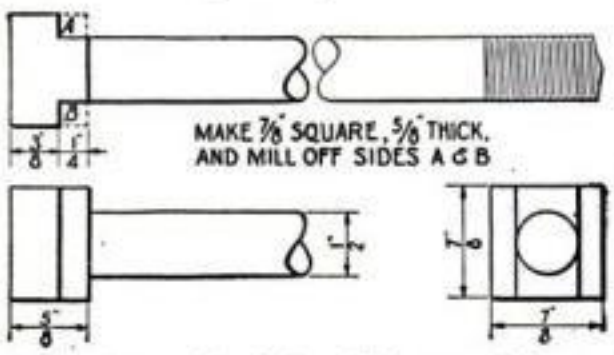




This method of interlocking can be used to make as large a gang of cutters as may be needed.

Nonslip Faceplate Bolts Are Aid in Machining

DIFFICULTY in strapping and the possibility of error in attaching a laid out job to the faceplate on an engine lathe are removed when the nonslip faceplate bolts illustrated are used. The bolts are made from 7/8-in. stock, as the head of the bolt is 7/8 in. square.—H. C.



Dimensions of the bolts, which are made from 7/8-in. stock and threaded to accomodate nuts.

CERTAIN precautions must be taken to insure success in cold weather concrete work. Not only must the mortar be kept above freezing during mixing and placing, but this temperature must be maintained to allow thorough hardening.

Midget Plane Flies Indoors

By
THOMAS CONDAX

The plane, just a little larger than a man's hand, is well suited for indoor flying.

DURING the winter months model airplane flying usually has to be confined indoors. This fact was responsible for the designing of the 5½-in. indoor flying model illustrated—a midget plane that well deserves the name of *Parlor Scout.*

Because of the simple construction of this model, it is a good starting point for the boy who has had little or no experience in model building, yet its unique design and unusual flying qualities make it a worthy project for the expert.

In constructing the wing, cut and sandpaper four 1/32 by 1/16 by 3½ in. pieces of balsa wood; also five pieces for the wing ribs. Assemble the wing with cement, being careful to get the proper ½-in. dihedral angle on each half. The wing is covered on the top with Japanese tissue, which is cemented in place with banana oil.

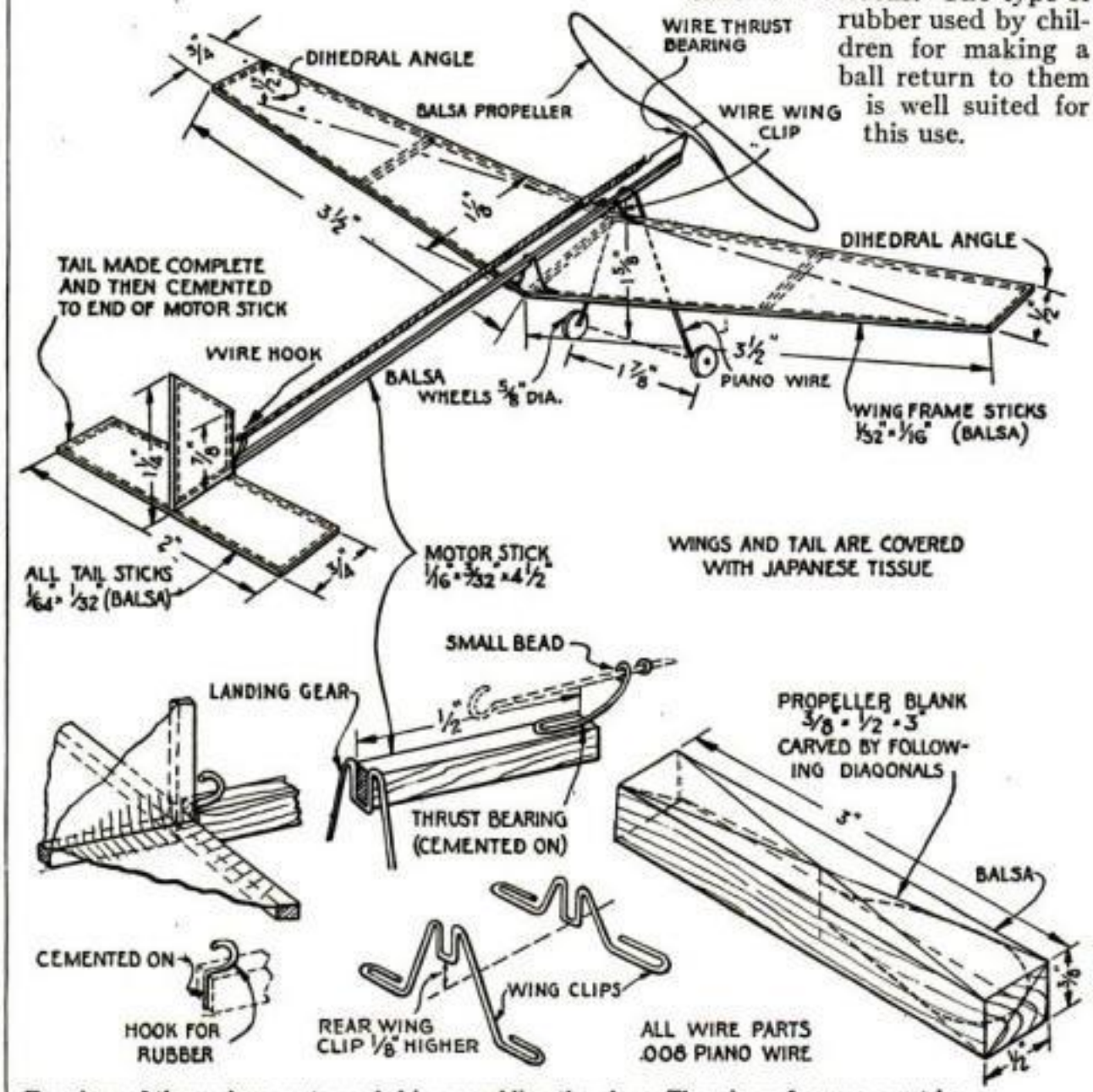
Construct a rectangle of thin 1/64 by 1/32 in. balsa strips for the tail. Cover it with tissue after applying a little banana oil on the frame. The rudder, covered with tissue on the left side as viewed from the rear, is placed in the center of the tail.

Cut and sandpaper the motor stick to the proper dimensions. The front thrust bearing and rear hook are made as shown. A small drop of airplane model building cement will secure them in place.

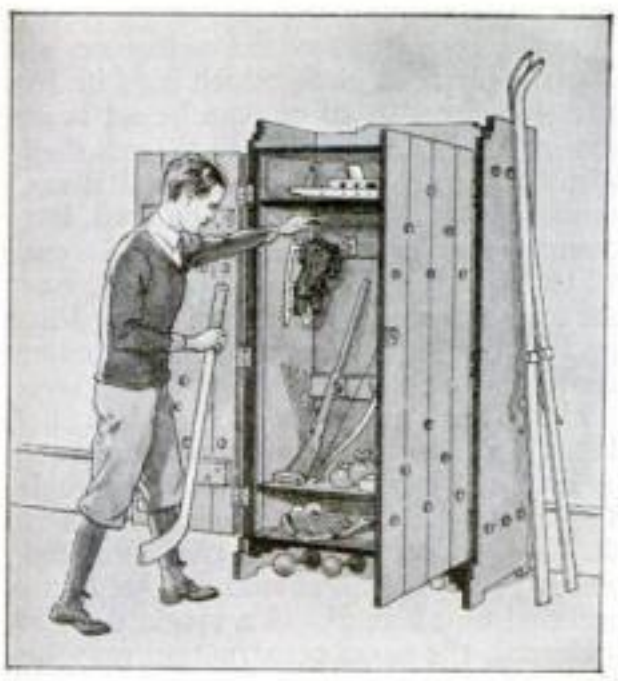
The landing gear is made from very thin music wire. A clip is bent in the top of the V to slip over the motor stick. The wheels, which are of balsa, can be held in place with a drop of cement on each axle.

The propeller is carved from a 3/8 by ½ by 3 in. balsa block.

The motive power is supplied by a 1/32 in. square single strand of rubber. A loop is tied at each end to allow it to be fastened to the hooks. The type of rubber used by children for making a ball return to them is well suited for this use.



Drawings of the various parts needed in assembling the plane. The wing, of course, must be located by trial, the final position being somewhere near the middle of the motor stick.



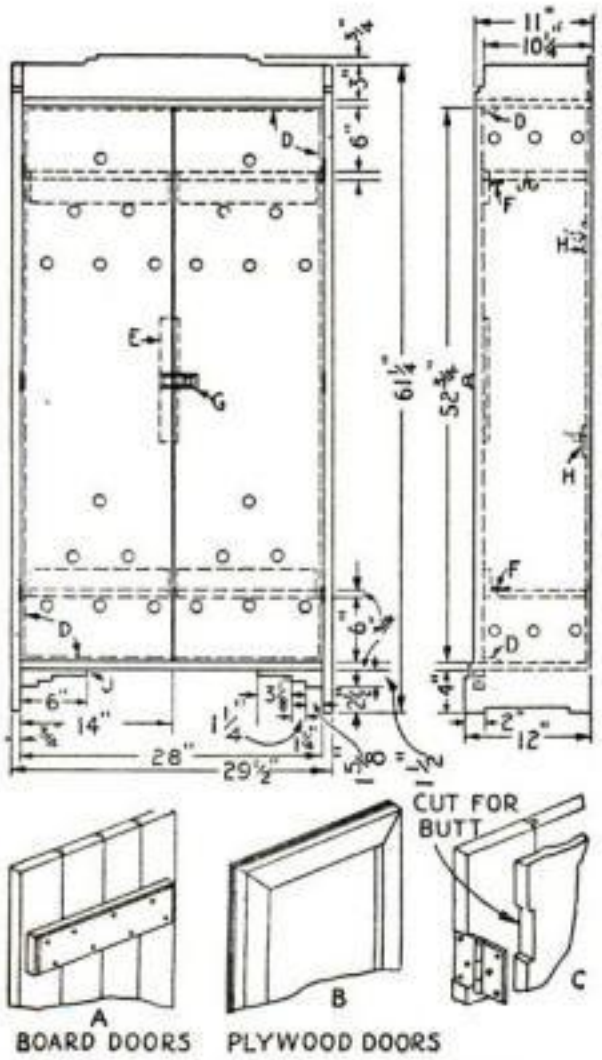
This roomy and ventilated locker provides a place for a boy to keep his sporting equipment.

A Sturdy Locker Made Cheaply

FOR storing a boy's sporting equipment and various treasures, this modernistic looking locker or closet is just the thing. Any handy boy can make one for himself.

First, the two ends ¾ by 12 in. by 5 ft. 1¼ in. should be made. Cut the decorative angles accurately, but, if extreme simplicity is desired, the embellishments may be omitted and the ends made the full 12 in. wide, which will allow each shelf to be made 1 in. wider. The top and bottom shelves should each be ¾ by 10⅝ in. by 2 ft. 4 in. and the inside shelves ¾ by 9 in. by 2 ft. 4 in. Bore 1-in. ventilating holes in the ends and smooth and sandpaper all outside surfaces.

Next, place each piece accurately and fasten with sixpenny finishing nails, be-



Assembly of locker, and two types of doors.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 5.

ing careful to keep the shelves ⅜ in. in from the rear edges of the sidepieces so that the plywood back, which is ⅜ in. by 2 ft. 4 in. by 4 ft. 10 in., can be set in as shown. The back is fastened to each shelf with fourpenny nails. If plywood is not available, ⅜-in. boards may be used, but then the ends of the boards should be cut off to lap only ½ in. on the back edge of the top shelf, and a backboard ⅜ by 4 in. by 2 ft. 4 in. should be made and fastened above it.

Make the two doors ¾ by 14 in. by 4 ft. 4¾ in., fastening the pieces together by driving 1¼ in. No. 10 screws through a ¾ by 3 by 13 in. cleat at each end as at *A*. If plywood doors are used, mitered pieces ¾ by 1½ in. should be glued and bradded on as at *B*. If a single door is preferred, the same construction may be used. Bore 1-in. ventilating holes as indicated, fit the doors carefully, and smooth and sandpaper them. Hang them with 2-in. brass butt hinges as wide as the thickness of the door will permit, cutting into the edge of the door as at *C*.

Place ½ by 1 in. doorstops *D* around the door opening and a ½ by 2 by 12 in. stop *E* back of the latch striker. Fit hooks and eyes or use some other device to hold the left or standing door as at *F*, and place either a latch as at *G* or a lock Insert clothes hooks to suit in the cleats *H*, under the upper inside shelf, and on the ends. Make brackets *J* and fasten in place with glue and brads.

Paint or lacquer in selected colors, say red inside and green outside, with black edges and perhaps a brilliant orange on the inside surfaces of the ventilating holes.—CHARLES A. KING.

Spirit Soldering Flux

A BETTER flux for the home workshop than the ordinary "killed spirits" may be made by dissolving stick zinc chloride in methylated spirits. The stick zinc chloride is sold in sealed glass tubes containing 1 oz., for about twenty-five cents. One ounce is dissolved in 6 or 8 oz. of methylated spirits or denatured alcohol, according to the strength desired. The latter proportion is quite satisfactory. This makes a cheap flux which has two great advantages over the regular acid solution. It can be applied with greater ease to the exact spot on the metal which is to be soldered and it will cover the area with a thin level coating, which dries almost instantly and leaves the intervening spaces bare. It also not only performs the office of flux more efficiently, but it does not chill the soldering iron as much as the other solution. A good test of its value may be made by applying the solution to a piece of hacksaw blade without brightening the surface. The solder will instantly take hold when applied with the soldering iron.—H. CALDWELL.

TO GIVE a weathered surface to new copper weather vanes, downspouts or other exposed copper, scrub the surface with a strong solution of caustic soda (in hot water) and rinse it thoroughly with cold water. Then brush on a solution of 1 lb. powdered sal ammoniac to 5 gals. water. Twenty-four hours after this treatment, sprinkle the surface with water.—A.E.E.

Stationery Cabinet Protects Paper

BY USING the easily made cabinet shown, it becomes a simple matter to keep stationery clean and where it will be readily accessible. Pine or basswood can be used in the construction. The top, door, and bottom are cut from ½-in. stock; the back and shelves from ¼-in. stock; and the ends from ⅜-in. stock. The brads used throughout are ¾ in. long.

Two 1-in. brass hinges hold the door in place. These are screwed in place with flat-headed screws after recesses have been cut to receive them. The catch used

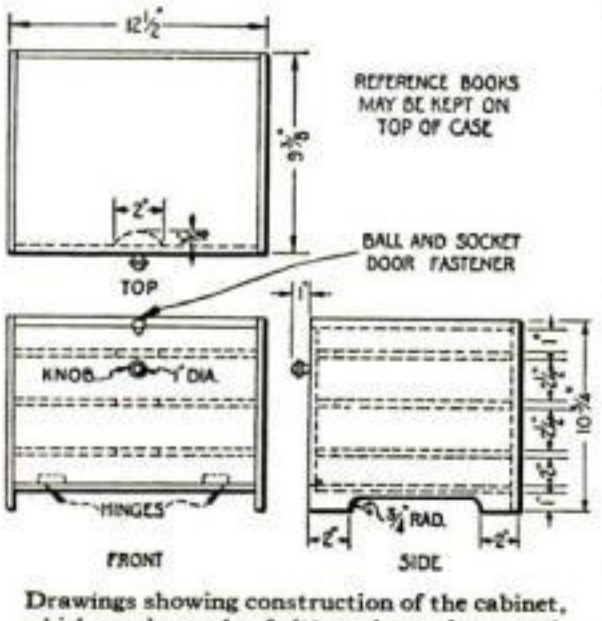
The cabinet can be stained to match the desk or painted or lacquered any color desired.

at the top of the door is of the ball and socket type.

The finished cabinet can be stained to match the desk or table on which it is to rest, or it can be painted or lacquered any color to suit individual taste.

In use, reference books can be arranged on top, carbon paper kept on the first shelf, writing paper on the second and third shelves, and unanswered correspondence and envelopes on the lower shelf.

When the door is open, it rests on the 1-in. diameter wood knob fastened to its front.—R. W. FOWLER.



Drawings showing construction of the cabinet, which can be made of either pine or basswood.

DIRT spots can be removed from wall paper by rubbing with fresh bread. Allow the bread to crumble, so that a clean surface will be constantly in use against the paper.

Refinishing an Auto Cheaply with a Paint Sprayer

By EVERETT EAMES

IF MODERN methods are employed, it is not difficult to refinish an automobile at home. Quick-acting chemical paint removers and electrically operated paint sprayers are rapidly replacing tedious scraping and brushing operations.

The cost of a small motor-driven spraying outfit can be more than saved by doing the job in one's own garage, and the outfit remains to become a permanent and valuable addition to the home work-

Cover the motor, wheels, and top with paper or old cloths before applying the paint remover.

shop equipment. Several reliable, ruggedly built outfits are now on the market, priced under fifty dollars.

Although not hard, the work takes time—for a novice, about forty hours of actual working time. With lacquer finishing there is no waiting for paint to dry, as one side of the car will dry while the other is being sprayed. The car therefore need not be out of commission more than a week or ten days, which is about the time required by a professional finishing shop.

Before the work is undertaken, the following materials should be assembled. The quantities listed are sufficient for a sedan having a 120-in. wheelbase and will cost about twenty dollars.

- 3 quarts paint remover
- 2 quarts red oxide of iron primer
- 2 quarts undercoat (color similar to finish)
- 2 quarts finishing lacquer for final gloss (sometimes called "retarder thinner"; it contains approximately 80 percent thinner and 20 percent body material)
- 1 gallon lacquer (total for one or more colors)
- 5 gallons lacquer thinner
- 1 tube glazing putty
- 1 gallon high test gasoline
- 1 gallon benzol
- 1 steel scraper
- 2 steel scratch brushes, one 2 by 6 in., and one ¾ by 6 inches
- 6 sheets No. 2/0 emery cloth
- 6 sheets No. 280 waterproof sandpaper (also numbered 8/0)
- 6 sheets No. 400 waterproof sandpaper (also numbered 10/0)
- 2 rolls masking tape (if two colors are to be used)

Sufficient tin to be cut into 3-in. strips for holding paper over the windows.

First, have the running gear washed at

Scraping off the old finish. The finish peels off easily when softened by the remover.

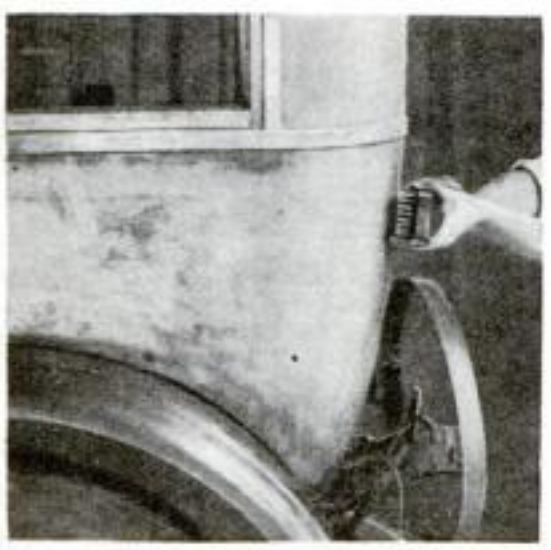
a garage under high pressure water and specify that the wheels be washed with gasoline to remove all grease. Then remove all easily detachable accessories, plated side lamps, and door handles. The engine hood should be taken off and used to experiment with; that is, every unfamiliar operation should be tried first on this part. Cover the wheels, engine, tires, and top with paper or rags.

Proceed to remove the finish as follows: Brush a coat of paint remover on the hood and allow it to stand until the finish crinkles up; then scrape the loose material off with the steel scraper. As some patches will be harder to loosen than others, another brushing should be given and the remover allowed to stand twenty minutes while a part of the body is being brushed over. The second treatment will loosen all but a few traces of paint in the corners and along the edges of the metal. Remove the thoroughly softened residue by scrubbing with the larger steel brush. Continue this process over all the steel parts, not overlooking the underside of the hood, but under no circumstances allow the remover to come in contact with any of the wooden parts.

All the steel should now be rubbed with the emery cloth until bright and clean, special attention being given to corners around windows and pressed in or raised parts of the body and seams which form any sort of decoration.

If the wheels are to be refinished, they may be removed and the tires taken off, but this is usually done after the body is finished, as the process is much simpler.

Before proceeding further, run the car out and sweep up the dried finish scraped from the body. Also sweep down the



Thoroughly clean the body of old paint by "scratch brushing" it with a wire brush.

walls of the garage and remove anything that would be injured by spots of lacquer. It is not necessary or desirable to wet down the walls or floor as in the case of other methods of finishing; in fact, the final three coats of lacquer should not be sprayed on in rainy or humid weather.

All the usual precautions should be observed in regard to fire. There must be no smoking nor open flames in the vicinity of highly volatile liquids, such as the gasoline, benzole, and thinner.

Good ventilation is also essential, for, although the fumes of lacquer solvents have a pleasant banana odor, continued breathing of the atomized material itself might cause dizziness to anyone unused to it. Keep a window and the main door of the garage open unless the breeze is too strong. If one is especially sensitive to strong fumes, a small respirator, costing fifty cents, may be worn while one is operating the sprayer.

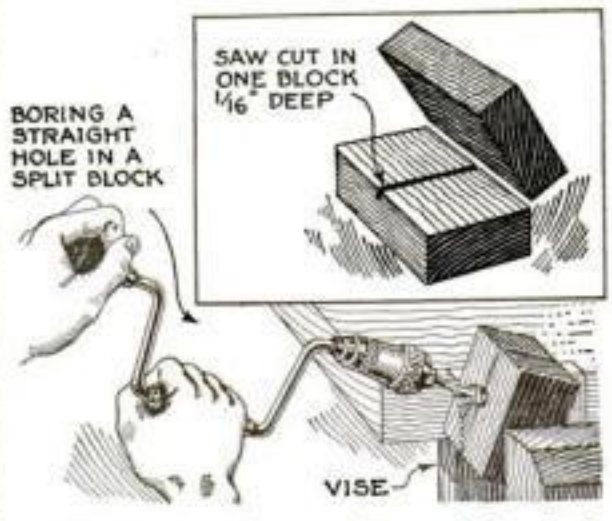
The metal must now be made chemically clean before it will properly "take" a coat of primer. To accomplish this, first wash the entire surface with high-test gasoline, preferably applied with a small bristle brush although a cloth will do. Follow this with a thorough washing with benzole. This will dissolve and remove the wax left from the paint remover.

Strips of tin cut 3 in. wide should now be pushed in around the edges of the windows, and newspaper slipped under them, so as to cover the glass completely.

In a following article, Mr. Eames will explain the procedure in applying the priming, surfacer, and lacquer coats.

Boring Straight Holes in Split Wooden Parts

FOR boring holes in wooden line shaft boxes, in wooden split pulleys, or in any parts where a true, deep hole is required between two pieces of wood, first make a pencil guide mark on the abutting face of one piece and saw the mark out accurately so as to leave a groove about



A saw cut is put in one piece, and then both parts are clamped in a vise for boring the hole.

1/16 in. deep extending clear across the block, as shown. Clamp the two pieces together so that there is no danger of their spreading and start the bit in the end of the groove. The point of the bit will follow the saw cut all the way through. I have bored holes 18 in. deep in this way.—WILLIAM RENFROW.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Toy Dancer Follows Music Perfectly

The toy is made to dance by beating time on the inside end of the wooden springboard.

THE toy illustrated, which can be made cheaply, will surprise you with its lively actions and clog steps. Grown-ups as well as children will marvel at the realism of this toy dancer.

The body is made from one piece of ¾-in. gumwood, or any available wood will do. It can be sawed out with a coping saw and then carved with a sharp pocket-knife, giving it a more realistic outline.

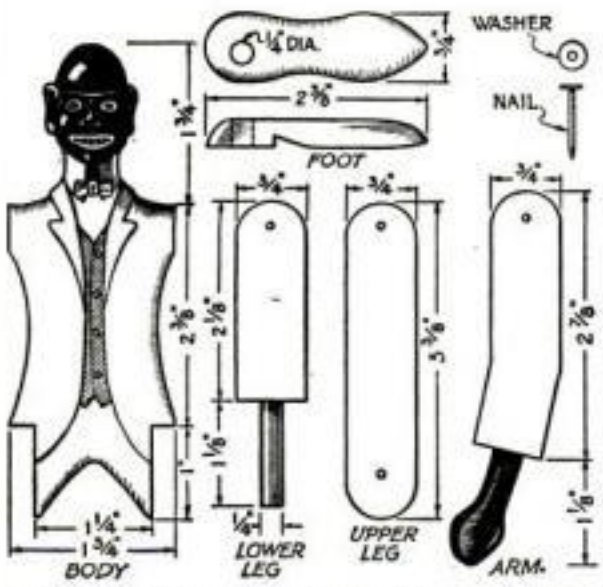
The head is also carved with a knife, and its elaborateness depends on the ability of the carver. The rest of the pieces are made from ¼-in. wood.

All joints are made by riveting the two pieces together with a cut-off nail. Be careful to see that the fit is not too tight. In attaching each arm, insert a small washer between it and the shoulder in order that the arms may swing freely.

When the body is completed, attach a piece of ¾-in. doweling 18 in. long in the middle of the back.

Procure a strip of hardwood 28 in. long and about 3/16 in. thick; this will act as the springboard for our dancer.

Seat yourself in a chair and insert one end of the springboard under one leg (see illustration). Take hold of the extreme end of the dowel and hold the figure in



Details of the various parts that go to make up the body of this animated toy dancer.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

position so that its feet will just rest lightly on the other end of the springboard. With your right hand beat time gently on the springboard. The "dancing fool" will keep time perfectly, and by beating time to any song you will find that he will dance vigorously in perfect rhythm.—DICK HUTCHINSON.

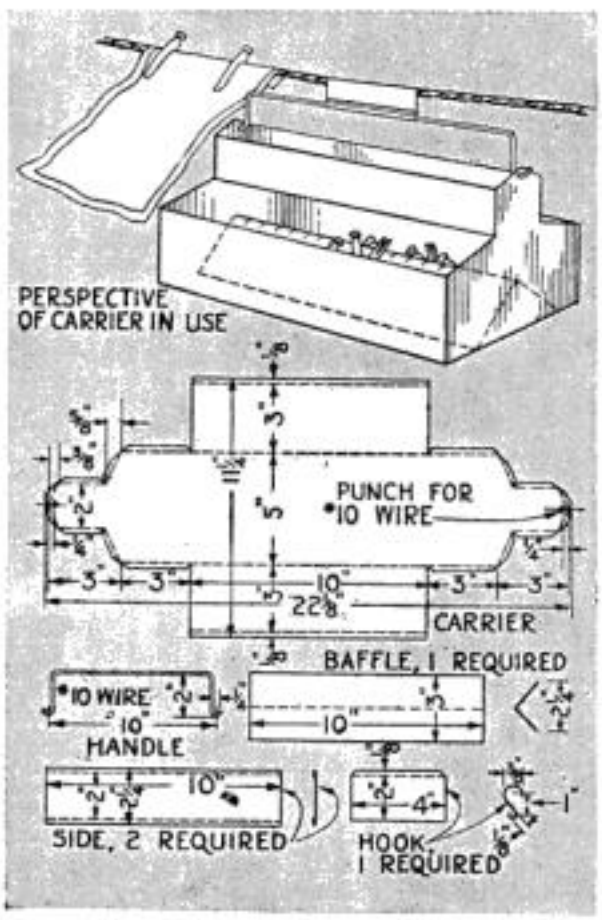
Sheet Metal Holder Keeps Clothespins Handy

THIS design of a clothespin carrier won first prize in the elementary metal working division of the shop problem competition for teachers conducted recently by the Educational Department of POPULAR SCIENCE MONTHLY. The design is the work of Mr. W. A. de Vette, of the manual training department of the Wilson Junior High School, Erie, Pa.

In an article which accompanied the sketches shown, he said: "The carrier was designed as a general shop project, one of the principal factors being to embody the greatest number of operations in a minimum of material.

"The carrier does not require an undue amount of time and therefore does not give the student's interest time to lag.

"The pattern involves in its construction not only cutting but folding, hemming, punching, soldering, and wire bending."



The clothespin carrier in use and the various sheet metal parts needed in the construction.

While it was intended purely as a shop problem, there are no doubt many home workshop enthusiasts who would like to make one of these carriers for part of wash-day equipment.

Leather Strop for Tools

A PIECE of leather glued to the top of the oilstone case makes an excellent strop for putting the final edge on a tool. It is desirable to make a second cover to fit over the leather and protect it from the dust, if the oilstone is not kept in a dustproof drawer or cabinet.

Hints on Remedying Sticking Doors

What should be done when a door binds at the hinge edge?

THIS defect may be the result of repeated coats of paint and varnish. Inspect the screws of the hinges carefully to be sure that they are driven home. If the door still gives trouble and the width of the crack along the lock joint will permit it, loosen the screws in the jamb and insert a piece of pasteboard between the butt (hinge) plate and the

Fig. 1. Sliding a piece of paper back and forth in the joint to locate where the door binds.

jamb. If this does not relieve the annoyance, proceed as follows:

Close the door and insert a piece of stiff paper in the joint (Fig. 1) as deep as the thickness of the door and slide it back and forth gently. The places where the door binds may thus be located, for the paper will move easily until it reaches the point of contact between the door and the jamb. Do this through the length of the joint, noting carefully the places where the paper does not pass.

Take the door off, place it on the lock edge (a convenient way to hold it is in a notched board fixed across a door opening), and remove the hinges. If available, a rough plane should be used to cut through the paint, which will dull any edge quickly; or a scraper may be used.

Plane the entire edge to prevent a possible repetition of the annoyance, but do not disturb the face corner, for this will be seen when the door is in its place. Note the amount of wood thus removed in shavings, and with a sharp chisel cut the recesses of the door to receive the butt

plates that much deeper. Reset the butt plates and rehang the door.

How is binding at the lock edge relieved?

Note the amount of wood that prevents the door from closing and compare it with the hinge joint of the door. A good craftsman seldom planes the front edge of a door because it involves removing the lock, setting it deeper, and changing the latch and bolt openings and the face trimmings. To avoid the conspicuous defacement of the door resulting from both these processes, take it down, remove the hinges, and plane the hinge edge for the entire length, fitting it carefully to the jamb. Plane only enough to allow the door to enter the jamb with a close fit. Sink the hinges a distance equal to the wood planed away. Be sure the back edge is planed a little under—that is on a slight bevel—to avoid hinge binding. Finish the raw wood to match the other surfaces of the door.

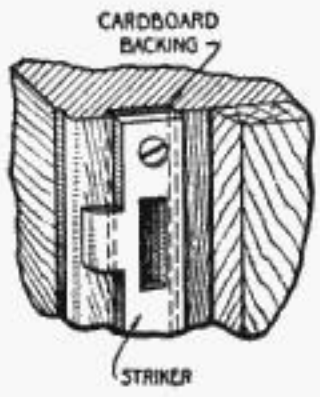


Fig. 2. Striker plate built out with cardboard to receive latch.

If a door is so loose that a latch will not catch in the striker, what should be done?

Although this is not a question of binding, it requires a word of explanation. If cardboard under the hinges will not push the door over enough to make the latch engage the strike plate, the latter may be built out to receive the latch by fitting a piece of heavy cardboard or wood behind it as in Fig. 2. Drive longer screws into the jamb to hold the striker in place. This method, although effective, looks like a makeshift, because no door should fit so poorly as to require the strike plate to be backed out.

When the latch or bolt will not enter the strike plate, what is the remedy?

One method is to remove the striker and file the openings on either the top or bottom. Another is to remove the plate, cut the recess in the wood longer, and reset the plate higher or lower to allow the latch and bolt of the lock to engage properly. The small recess above or below the plate can be filled with a plastic wood composition.—C. A. K.

Coming Features

How to Construct an Outboard Motor Boat

Wiring a Private Garage

Making Molds in Plaster of Paris

A Sole Leather Jewel Box

Wire as an Aid in the Machine Shop

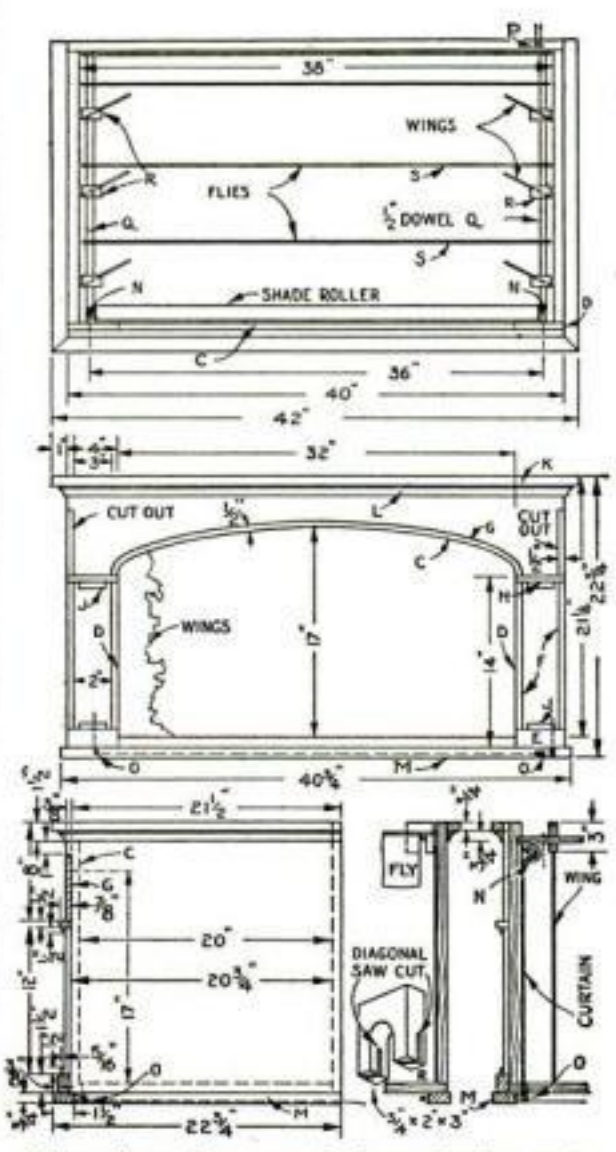
Building a Model of the Famous Ferdinand Schulz Glider

The Lathe—Its Care and Use

Complete Miniature Stage and Scenes

A MINIATURE stage, besides being a plaything for children, is of value to anyone, young or mature, who is interested in marionettes or who is a student of costuming, dramatic grouping, or scenic effects. As the scale is an inch to a foot, the stage illustrated is large enough for really worth while presentations and allows ample room for properties and scenery constructed upon the same scale.

Make the bottom of the box ¾ by 20¾ in. by 3 ft. 4 in., the two ends ¾ by 21¼ by 20 in., and the back ¾ by 22 in. by 3 ft. 4 in. The lintel *C*, ¾ by 8 in. by 3 ft. 4 in., is shaped as shown. The two architraves *D*, ¾ by 4 by 14 in., and *C* may be assembled with sixpenny finishing nails; note that *D* is flush with the bottom of the box. Make two bases *E*, ⅞ by 1½ by 4 in., two pilasters *F*, ⅜ by 3 by 12 in., one lintel *G*, ⅜ by 8 in. by 3 ft. 4 in. shaped as shown, two capitals *H*, ½ by ⅞ by 4 in., and four blocks *J*, 5/16 by ½ by 2 in. The cap *K*, ¾ by 1¾ in., and scotia *L* are



Dimensions of stage and plans showing positions of the wings, flies, curtain, and back drop.

both placed on the front and ends and have mitered corners. Also, ¾ by 1½ in. pieces of about the same length should be fastened to the bottom as at *M*. Small electric bulbs may be placed here for footlights, if desired.

The drop curtain may be a window shade, with the roller cut to 36 in. wide and the fixtures placed at *N*. Fasten cords to each end of the lower edge of the curtain, and pass them through the floor and pulleys *O* and through a screw eye at *P* at the back of the stage. Place ½-in. dowels at *Q* and make six wing guides *R*.

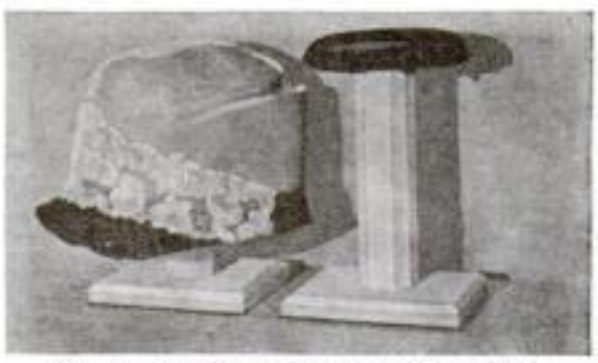
One set of scenic backs will consist of the following: six wings of heavy pasteboard 5 by 18½ in., with the edges cut to suit the set; and four metal ¾-in. rods *S*, three of which will support the cloth or paper flies 5 in. wide and 2 ft. 11 in. long—each of these must have a casing sewn at the top to receive the rod *S*. The background drop is 2 ft. 11 in. long and covers the entire back. The rods may be withdrawn and used for as many sets as desired.

The stage front and ends offer opportunities for as elaborate gesso or plastic ornamentation and decorative treatment as desired.

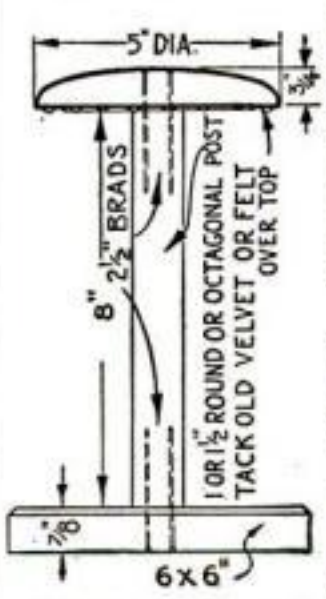
Handy Wooden Stand Keeps Women's Hats in Shape

INDIVIDUAL hat trees are used in department stores not only as exhibition stands but also to preserve the shapes of the hats. These little stands conform to the rounded shape of the crown and hold the brim out of contact with the shelf.

As will be noted from the sketch and photo, these trees are simple in construction and can be put together in a few minutes. The pedestal is made of soft pine, allowing nails to be driven into it easily. Both ends should be squared off in a miter box. Tack a layer of old velvet or felt over the top and paint the lower parts white or cream color.



The stand holds the hat free of the shelf.



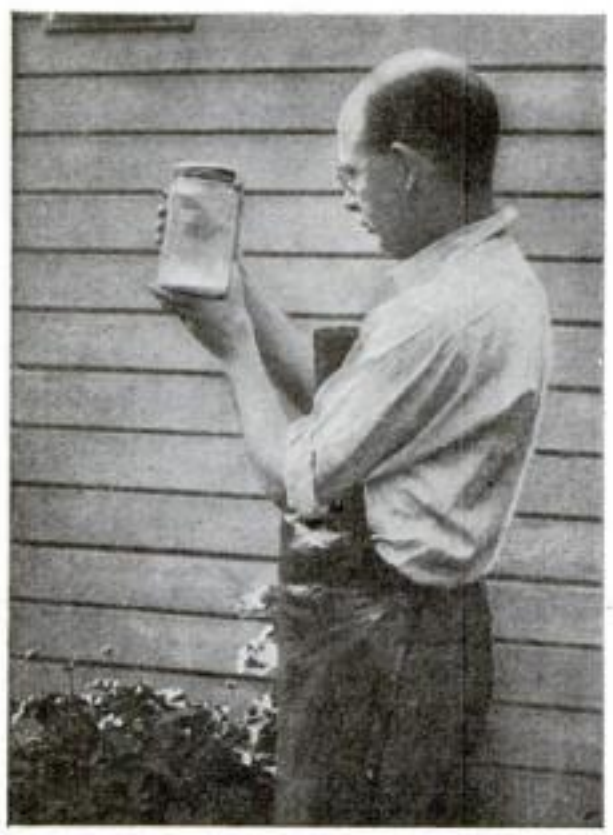
Soft pine can be used for all of the parts.

By making a set of these useful hat stands for your wife's closet, you can improve the appearance of the upper shelf and also aid in preserving the shape of her hats.—E. E. EAMES.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THERE are at least three good reasons why the amateur painter should learn a few simple tests for paints, even though carrying them out may require a little more care and trouble than just stirring up the mixture in the can and applying it. The first reason is that a knowledge of these tests puts a man in a position to recognize good paint from bad and to be a discriminating purchaser. Secondly, there is a trick in matching colors and surface gloss which the handy man should know if he is going



Testing for the presence of lead oxide in a paint by the use of the hydrogen sulphide jar.

to paint over some repair job which he has just made, and mix up a small batch of paint to match the main color. Lastly, when working with light colored tints, it is often well to test for that special white pigment which, in certain uses, gradually changes to a gray or even to an inky black. The methods of testing paints given below are used by the U. S. Government chemists.

A good ready-mixed paint is one that has been well ground and that can be readily mixed to a smooth brushing consistency with a paddle. It should dry within 18 hours to a full oil gloss, without sagging, streaking, running, or chalking. The weight per gallon of a ready-mixed red, green, or white paint of good body should be at least 12 lb., and of a black paint at least 9 lb.

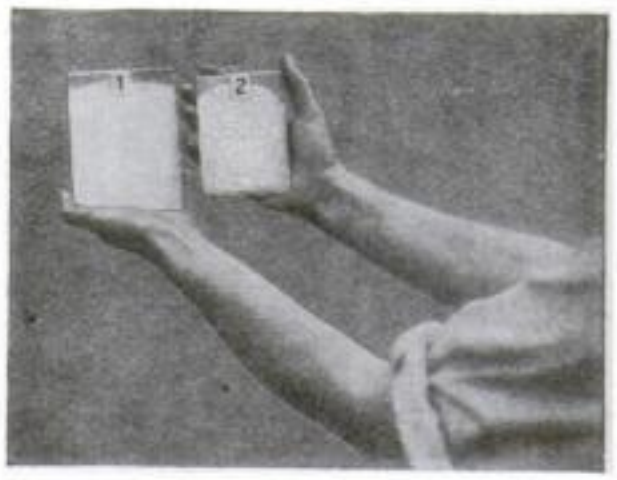
The tests for fineness, drying, and film characteristics are made in the following way: Using a good grade of brush, paint two or three clean, dry, 4 by 5 in. tin panels. Note whether the sample works well under the brush and has good "hiding power." Examine the wet film from

A definite program for getting ahead financially will be found on page four of this issue.

an angle. A poorly ground pigment betrays its presence by particles and specks which give a rough appearance to the surface. Leave the panels in a vertical position in a well ventilated room for 18 hours. At the end of this time a good paint should be fully dry and have a smooth, glossy surface, free from defects.

In matching colors and gloss, one of the two paints is brushed on one half of a 4 by 5 in. glass panel, while the other is brushed on the other half. The panel is then reversed and the shades compared as seen through the glass. This way of matching colors avoids any optical illusion due to physical differences in the surface of the films. Allow the panel to dry for 18 hours and then compare both sides at such an angle as will give a good reflection of light from the surface of the paints. The films should have the same degree of gloss to be considered a match.

The exasperating habit of blackening when exposed in a kitchen, bathroom, or



By coating tin panels, paints can easily be examined for drying qualities and hiding powers.

even an outside wall if exposed to sulphur fumes, which characterize some light colored paints, is due to a chemical change in the white lead pigment and can be avoided by a simple test for lead in the paint followed by a substitution of some other brand if the test is positive.

To test for lead apply the paint to two 1 by 2 in. tin panels. The next step is to make hydrogen sulphide, which is the form of sulphur which blackens lead paint. This can be done conveniently by placing about one tablespoonful of either dry lithopone, ultramarine blue pigment, or ordinary "bluine" washing compound (or any other dry sulphide) in the bottom of a quart mason fruit jar and adding a tablespoonful of water and a similar amount of muriatic acid or oil of vitriol. When the gas starts bubbling off suspend one of the small paint panels by a thread inside the jar, out of reach of the liquid in the bottom. Stopper the jar so that the gas can have plenty of opportunity to attack the paint. The other panel should be placed in a sulphide-free room. At the end of 18 hours, open the jar and compare the panel with the other one. The panel which was in the jar should not be darker than the one not so exposed, if the paint is to be used in a kitchen or bathroom.

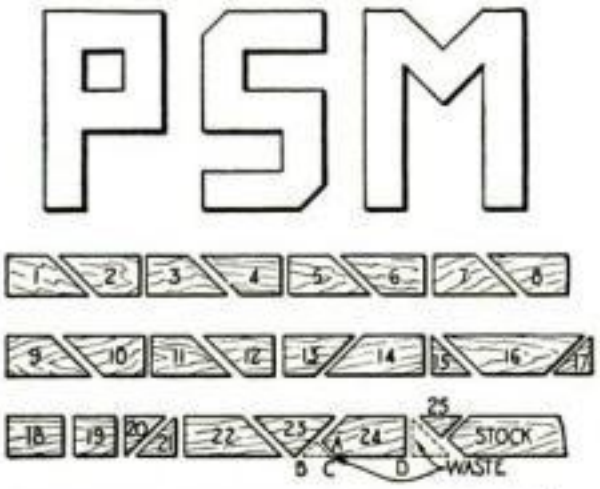
White lead, or a mixed paint containing it, can be mixed with all common pigments except lithopone, zinc sulphide, and ultramarine blue, for when put in contact with these it darkens and becomes dirty looking.—W. H. HAMMOND.

Two Block Puzzles That Test Skill

HOW well can you solve block puzzles? The two illustrated below are easy to make and will perhaps give you a surprise in working out the solutions.

The wood used can be either ½ or ¾ in. square, and dimensions for both sizes are given. If the two puzzles are cut from the same stock one set should be marked in some unmistakable way.

The pieces can be cut from heavy cardboard, if preferred, but the cardboard must be the same on both sides, as some



The pieces can be cut from either ½- or ¾-in. stock. The size of letter varies accordingly.

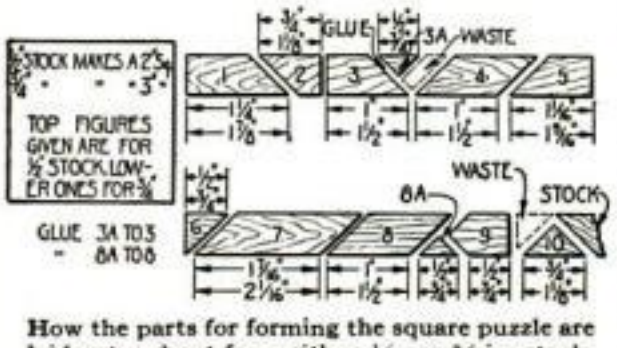
Sizes for Letter Puzzle

Piece No.	Length ½-in. stock	Length ¾-in. stock
1 to 11	1 in.	1½ in.
12 to 13	⅞ in.	15/16 in.
14	1¼ in.	1⅞ in.
15, 17, 20, 21	½ in. on short side	¾ in. on short side
16	1¾ in.	2⅝ in.
18	11/16 in.	1 1/16 in.
19	½ in.	¾ in.
22	1 3/16 in.	1 11/16 in.
23	1 in. on long side	1½ in. on long side
24	1¼ in. to point *B*	1⅞ in. to point *B*
25	½ in. on long side	¾ in. on long side

Point *B* on No. 24 is cut at *C*, which is ⅞ in. or 15/16 in. from *D*. Point *A* is 1/32 in. off center for ½-in. stock, and 3/16 in. for ¾-in. stock.

of the pieces have to be reversed after being cut. Number each piece as indicated.

If wood is used, be sure that the cuts are marked correctly, both in respect to length and position. This applies especially to pieces *9* and *24* in the P. S. M. puzzle. Point *X* in block *9* must be



How the parts for forming the square puzzle are laid out and cut from either ½- or ¾-in. stock.

A definite program for getting ahead financially will be found on page four of this issue.

centered after cutting off piece *8A*. Glue *3A* to *3* and *8A* to *8* as shown, and be careful to see that the joints are smooth and square.

The ½-in. stock makes all letters 2½ in. high—letters P and S are 1½ in. wide, and M is 2 in. wide.

The ¾-in. stock makes all letters 3¾ in. high—letters P and S are 2¼ in. wide, and M is 3 in. wide.

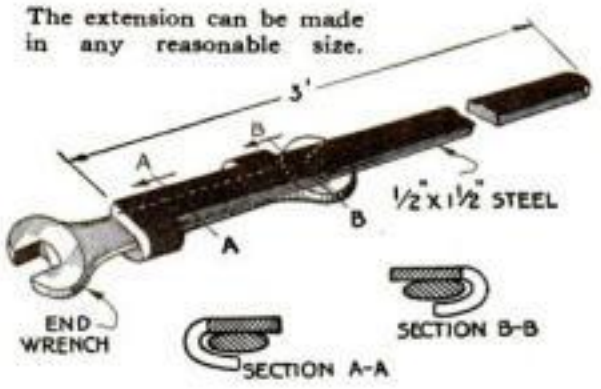
The answers to these two puzzles will be published next month together with two more skill-testing puzzle problems.—ERIC B. ROBERTS.

Wrench Extension for Use on Heavy Work

WHILE it is usually bad policy to use too much force in applying a wrench on nuts, it is occasionally necessary to pull nuts exceedingly tight. Cases in point are bolts for holding tools in stamping machines, draw rods for pulling bushings into place, or for loosening nuts that have rusted.

Rather than use a pipe over the wrench, or put a pipe wrench on a finished nut, it is better to make an extension for an ordinary open-ended wrench such as is shown in the illustration. This can be made of ½ by 1½ in. flat steel for the common sizes of wrench. The hooks are forge-welded on.

By varying the proportions, the extension can be made to fit any reasonable size of wrench.



Hints on Applying Paint on Metal Surfaces

GUTTERS, downspouts, and the like should not be painted until particular care has been taken to remove all rust, scale, and dirt with a wire brush, putty knife, and sandpaper, and by scrubbing with kerosene, if necessary. It is important to remove all rust; for rust, even if painted over, will eat its way through the paint.

For the priming coat on new metal surfaces, it is best to use red lead or some other metal protective paint. For the following coats, regular house paint of the desired color may be used.

New galvanized iron and tin is always covered with a greasy film, to which paint will not adhere properly. The surface should be washed thoroughly with vinegar, which will remove this oily substance. For the first coat, red lead or some other metal protective paint, or a specially prepared galvanized iron primer, should be used. The following coats may be of any good outside house paint.

Deceptive Trout Flies Have Soft Rubber Detached Bodies

BY USING a small sliver of light-colored automobile inner tube for the detached body, it is possible to make realistic trout flies inexpensively and easily.

Trout fishermen who believe that the artificial fly should be a counterpart of the living insect agree that the detached body of the fly is of the utmost importance. These men are the formalists, as opposed to the colorists, who believe the imitation must be the same in color as the living flies on which trout feed.

The detached body of the fly has been made in many different ways—feathers,

The finished fly resembles in every way the actual insect on which trout generally feed.

fine wire, horsehair, silk, and fine sewing needles have been used in its construction. All of these, however, serve as poor imitations, since they tend to make the body stiff and quite unlike the soft tapering body of the living insect. Rubber is much better because it is both soft and pliable and can be cut to the desired form, thus adding to the realism of the fly.

The hooks used should have a shank 1 in. long and be of the straight-eye type. However, if none is available, the turned-down type can be used and the eye clipped off.

Bend the hook as shown on the following page so that the fly will ride the water in an upright position in the same manner as the natural fly. Attach the gut snell to the hook by binding it on tightly with silk thread thoroughly coated with shoemaker's wax. (See Step No. 1.)

Then, as shown in Step No. 2, place the rubber body and carefully bind it to the hook, leaving about 1 in. of the rubber free.

In attaching the feathers, which represent the wings, place them on the hook with the quill ends forward and the feather tips back, and bind them in place.

Next, bend the feathers forward, as shown in Step No. 3, and hold them in place by crossing the binding thread in back of them. The feathers must be set carefully, as it is imperative that they always remain in a standing position.

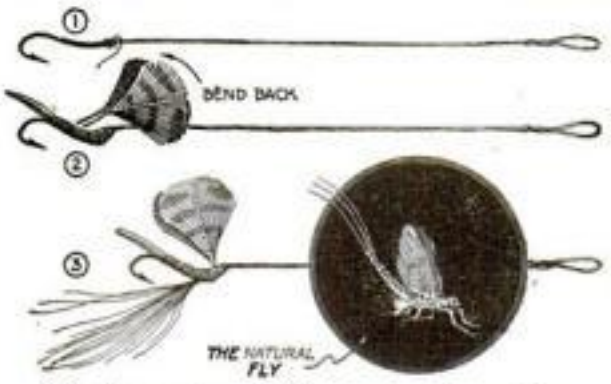
A few hairs can be taken from an old bucktail and tied just below the head. These simulate the feathery legs of the actual insect.

Wax all of the bindings thoroughly and then coat the body and detached part of the fly with a good grade of fly-making

varnish, after which the whole body should be sprinkled lightly with silver crystals, which can be obtained from any art store. The varnish will dry and hold the silver particles in place. These supply the glitter that aids in attracting the trout.

Better results often can be obtained by using feathers of various colors. Experiment until you find a combination that meets with success.

A small vise is an aid in holding the fly for binding, but you will soon become proficient in doing the binding by hand. Then you can make flies to copy the exact



The three steps in the construction of the fly and a sketch showing the actual insect.

insects that the trout are feeding on in the particular stream in which you are fishing.—R. P. LINCOLN.

Tightening Loose Casters

CASTERS which have a horn projecting into a hole can be kept from falling out when the furniture is lifted by wrapping friction tape or rubber bands around the stems.

To tighten a caster of the socket type, remove it, wrap tough paper or cambric around the wood over which the socket fits and glue well.

Home Workshop Uses for Old Dental Tools

WITH a little shaping, discarded dental tools can be turned into useful additions to the home workshop tool chest. Because these tools and drills must stand the strain of cutting porcelain and bone, they lend themselves well to many of the delicate and difficult little jobs that the home worker so frequently encounters.

Broken hand instruments can easily be formed into excellent wood or linoleum carving tools, especially fitted for work where there are many small cuts and corners to be made.

The small drills are excellent for drilling fine holes in hard materials. Their shortness and stockiness allow a greater amount of pressure to be used than is possible with the average long, slender twist drill.—SAMUEL GORE.

IN BUILDING any boat it is best to attach the side planks to the rabbet in the stem first, and then spring them around and join them to the transom last. This permits fitting the sides to the curve of the stem. If the wood of the side planks is too dry, thus presenting the danger of splitting, it should be steamed or soaked in hot water until it conforms to the curve without too much strain.

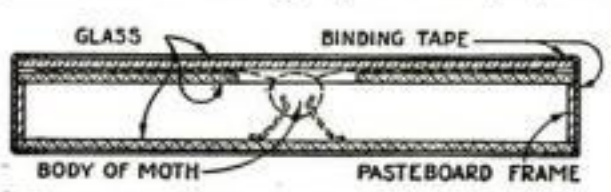
Glass Mount Allows Underside of Moth to Be Viewed

By J. G. PRATT

The finished case showing the moth in place with its wings between the layers of glass. The specimen is known as *Samia cecropia*.

THE easily made glass mount illustrated permits the inspection of moths and butterflies from both sides and also is effective as a wall or mantel decoration.

Cut a strip of cardboard from ½ to ¾ in. wide and sufficiently long so that it can be bent into a square or oblong that will allow a ½-in. margin all around the specimen. The ends can be fastened together with binding tape. Also prepare



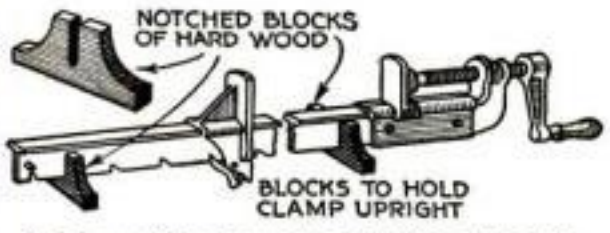
The top and bottom are glass, and the sides cardboard. Binding tape is used on the corners.

two sections of glass to cover the top, and to support the wings of the specimen, allowing sufficient room between for the body, as shown.

When the moth is placed in position, a sheet of glass to cover the whole top is fastened all around with tape. Before placing another piece of glass on the bottom, it is well to fasten a small piece of moth ball in one corner as a preservative. Next, the sides can be covered more decoratively, if desired.

Supporting Bar Clamps

WHEN boards are to be glued up on the workbench, it is often difficult to keep the cabinetmaker's bar clamps from turning over. Blocks, cut from any



Hard wood blocks used to hold the clamp upright for easier adjustment of the ratchet stop.

hard wood as shown, will hold the clamp upright. Where the clamps are not all of the same make, blocks are provided so that all will rest at the same height from the bench.—GRAHAM STUCKEY.

Finishing the *Bluenose*

A base having imitation waves adds to the attractiveness of the model.

By

E. ARMITAGE MCCANN

AS THE rigging on our model of the *Bluenose* nears completion, the little fishing schooner takes form and begins to display its full beauty.

Since the rig of a schooner is its most characteristic feature, and since clean-cut, seamanlike rigging is always the distinguishing mark of a high-grade model, it is imperative that the rigging on the *Bluenose* be assembled with meticulous care.

For those who wish full size drawings, a set of blueprints can be obtained by sending seventy-five cents for Blueprints Nos. 110, 111, and 112 (see page 97).

In shipping the main- and foresails, wire a triple 3/16-in. block to the main boom and a double one of the same size to the fore boom.

Reeve the masts through the mast hoops and put the jaw-supporting rings and mast-coat rings in place. Drive a short double-ended nail into the heel and step the lowermasts, being very careful that they are truly in line with the stem and slope at the right rake.

Fasten 1/8-in. blocks to the three eyes abaft the foremast head and to the four at the main. Reeve a line up through the top one and through those on the gaff bridle blocks and mast alternately. At the fore, pass one end of the line under the cleat on the fife rail and make it fast there; to the other end fasten a single block. This block and another fastened to an eye in the rail abaft the rigging and to starboard form a block and tackle. This forms the peak halyards.

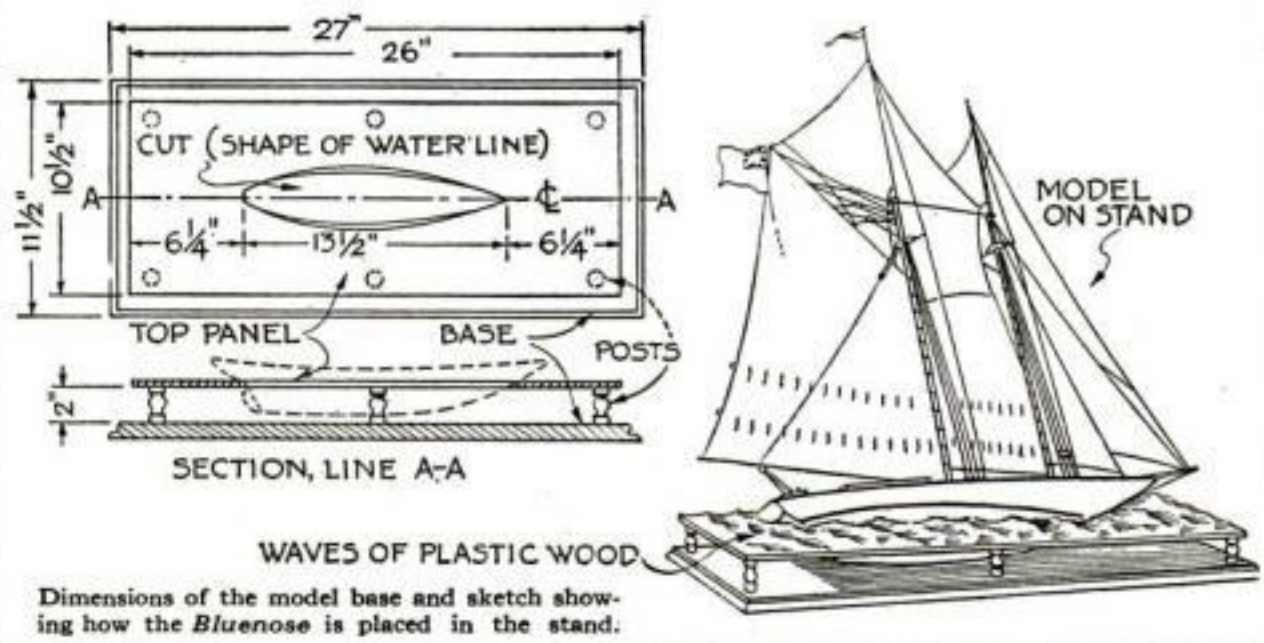
Wire a double 3/8-in. block to the masthead above the crosstrees and reeve a cord through this and the block on the gaff, bringing the standing end to the starboard side of the fife rail. Fasten the port end to the port cap rail with single and double 1/8-in. blocks. This rig forms the throat halyard.

Pull all these lines fairly tight to hold your sail about in position.

The halyards at the main are rigged in the same manner except that the standing and hauling ends are fastened on opposite sides.

Nearly all of the blocks on the actual *Bluenose* are iron bound with hooks or shackles, but in making the model it will suffice to strop (strap) them with medium thickness white sewing cotton. With the exception of the peak and throat halyards, the fall or line for all purchases or tackles starts at the heel of one of the blocks. The end of the falls should be fastened under the blocks before the strops are drawn tight. All the blocks are painted white.

In making my model I used No. 9 thread fishline for the shrouds, breast stays, and topping lift; a linen cord less than half that thickness for the halyards



Dimensions of the model base and sketch showing how the *Bluenose* is placed in the stand.

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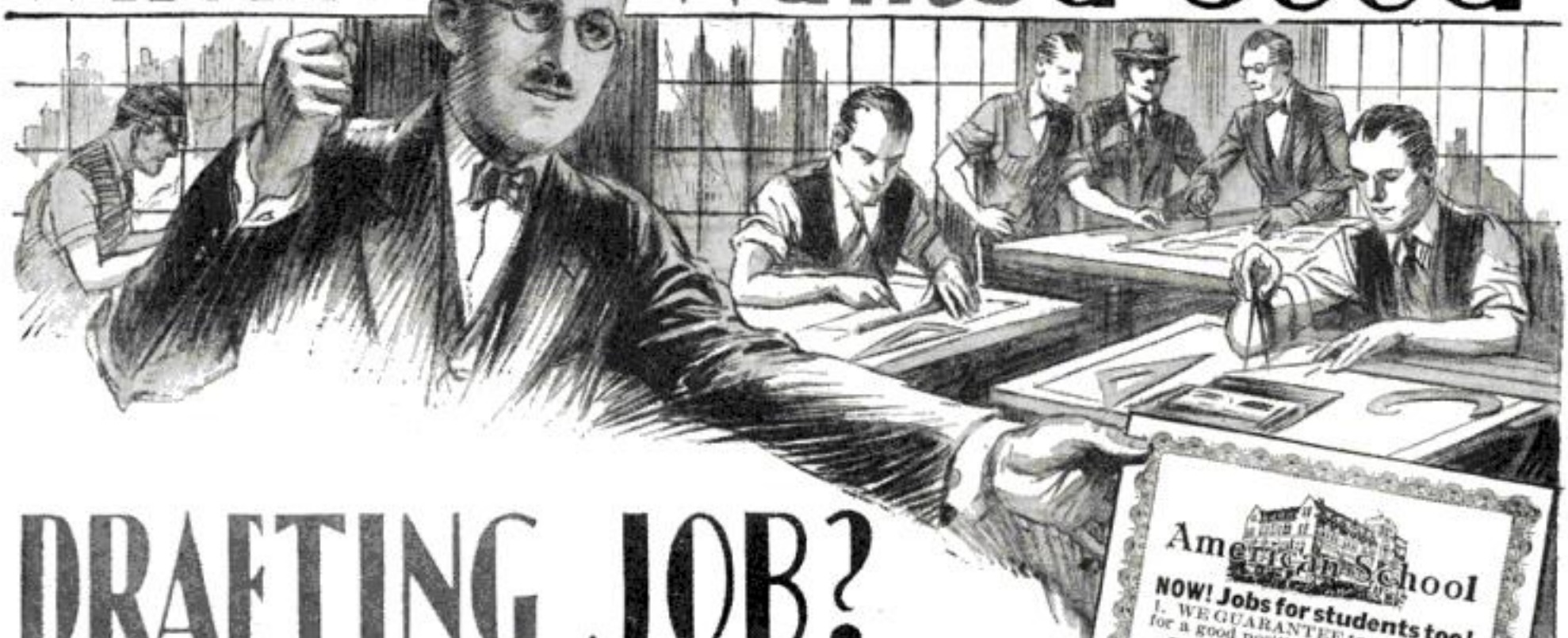

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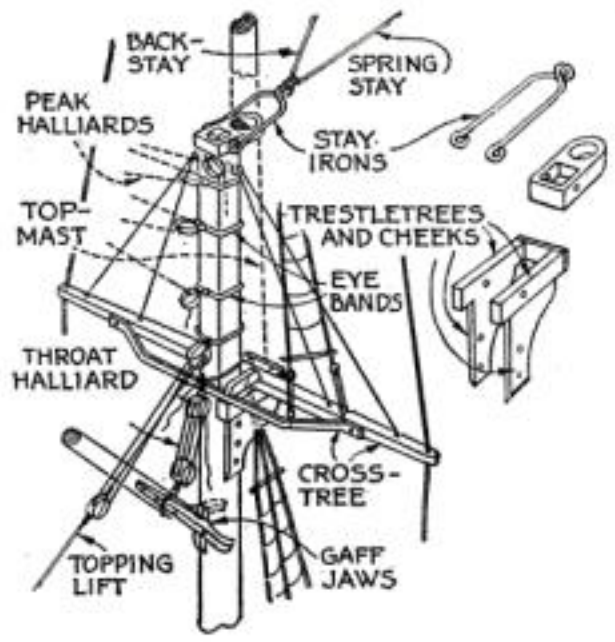

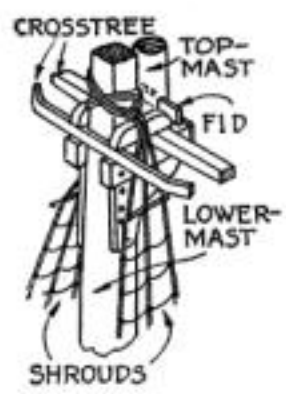

How the rigging on the crosstrees is arranged. Topmast shrouds need have lanyards only.

and sheets; and No. 24 sewing thread for the downhauls and light lines. For the stays I used two strands of No. 22 silk covered magnet wire twisted together and dyed black.

The bowsprit shrouds are made of three twisted strands of magnet wire or cord and are run from the inner eye bands to plates nailed to the hull. The bobstays are similar but thicker, and run from eyebolts in the stem to the eye bands at the bowsprit end.

The three shrouds on each side can now be rigged. Take the first up on one side and down the other and fasten it to a ⅛-in. deadeye which in turn is fastened to those on the hull. The two deadeyes should be about ⅜-in. apart, center to center. The next pair will go on one side around the masthead and down again on the same side.

Attach ratlines (steps) across all three shrouds. These may be made of No. 24 black cotton, spaced 3/16 in. apart and clove-hitched to each shroud. (See sail plan, P. S. M., Jan. '30, p. 94.) When all of the shrouds are in place, give them a coat of black shellac varnish and cut the ends off close with a razor blade.

In attaching the topsail fasten a ⅛-in. block to the peak, and hitch a line to the sheet clew and another to the tack. Sew the mast hoops on and the five small rings needed for the downhauler.

Pass the mast through the mast hoops and cap and set it in the trestletrees. Reeve a line through the masthead and peak blocks for the halyard and run it under the staple in the deck, finally making it fast to the pin on the fife rail. Reeve the sheet through the gaff end and jaw blocks and then to a pin in the fife rail.

Set up the topmast shrouds with lashings to the crosstrees and give them ratlines as high as the lowermast tip. Set up the breast stays with an eye over the masthead, passing them through the holes in the ends of the crosstrees, and then to the deadeyes and lanyards.

Stitch small wire rings at ¼-in. intervals along the head of the staysail and lace the boom on with a double block to the traveler. Pass the loop of a piece of the magnet wire through the lower iron at the masthead, twist it up, pass it through the rings, and fasten it to a staple driven into the platform at the bow. Fasten one of your smallest blocks to the peak and another to the iron, reeve off the halyard, and fasten it to the fife rail.

The rigging of the jibs and their stays is similar to that above, except that instead of a boom at the foot they have long sheets with pennants and falls. The lee sheets come straight down to eyes and belaying pins in the rail, and the weather sheets pass over the stays to their corresponding pins.

The jibs have downhauls starting at the peak and threaded through a few of the rings, through small blocks and then fastened to pins in the forward platform.

The topsails have downhauls which start at the first ring and pass through a ring at the tack, up through others on the foot and after leeches, through a block at the peak, and then to the deck.

The stays between the masts are the same as the head stays and are rigged to the mastheads and stay irons.

The last sail to go up is the fisherman's staysail. (While this is used on fishing schooners, it may be left off in the making of a model.) This hoists to the mainmast head with two small blocks, and to the stay iron with one block. The tack comes down to the fore fife rail and the sheet is double. The ends lead well aft and the one on the lee side is fastened up tight.

Put wire strops on the lower boom sheet blocks, forming eyes at the heels to run on the sheet travelers. Fasten these in the deck and reeve off the sheets. The amount of slack necessary will depend on the chosen direction of the wind. To keep them in the right position, tie preventer sheets to them and to the cleats in the lee rail. Then give the sheets a coat of varnish to keep them stretched and in position.

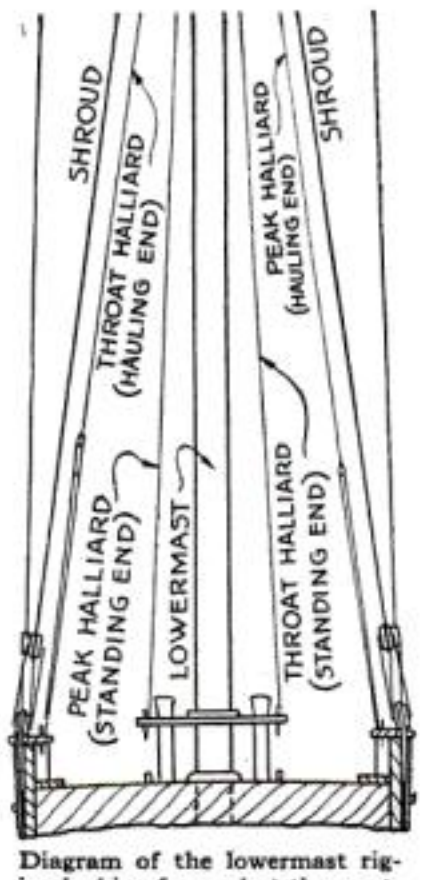

Diagram of the lowermast rigging looking forward at the mast.

The tacks on the topsails are to leeward of the peak halyards and to windward of the gaffs. If the fisherman's staysail is used it should set to windward of the foresail.

Red and green side lights and their screens are lashed to the rigging about 1¼-in. from the deck, the green on the starboard or right side and the red on the port or left side, look-

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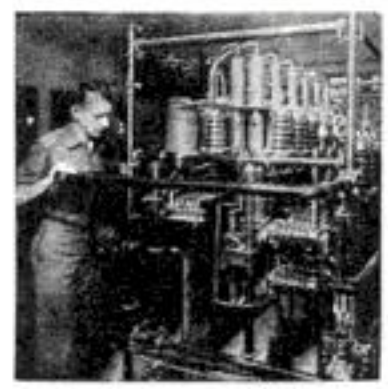

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ing from the stern forward. I used red and green glass jewels from ten-cent hair ornaments for my lanterns, setting them in the corner of an L-shaped piece of wood which is painted red or green inside and white outside.

The *Bluenose* flies a small colored pennant at the main and the Nova Scotia ensign at the peak.

By setting the schooner in a stand made to represent imitation waves, the model takes on quite a realistic appearance, especially if the sails are bellied.

The stand is made of two pieces of ¼-in. three-ply wood 10½ by 26 in. In one, cut a hole to take the hull when it is leaning over, as shown on page 122, and set in to an average depth of a little above the water line. The lee water line should be in the water and the weather water line should be out of it, with the bow perhaps ¼ in. higher than the stern. To get this hole just right try it out first on a piece of stiff cardboard.

Bore six holes through the two pieces as shown in the ends of the supporting posts. Make six posts about 1¾ in. long, with ends to fit the holes. To improve the general appearance a molding can be run around the lower piece. Stain and varnish all the parts except the top, on which the imitation waves are placed. These can be made of any plastic material painted blue or green with whitecaps scattered here and there. Remember to keep the run of the waves at right angles to the direction of the wind.

Glue some absorbent cotton around the hole and set the schooner in it and your model and stand are complete, sailing along "at the rate of knots," though not getting anywhere.

THOSE who have, in completing the fishing schooner *Bluenose*, finished their first model and wish to continue this delightful hobby, will find many interesting, picturesque, and historic ship models listed among the POPULAR SCIENCE MONTHLY Blueprints (see page 97 under Ship and Coach Models.)

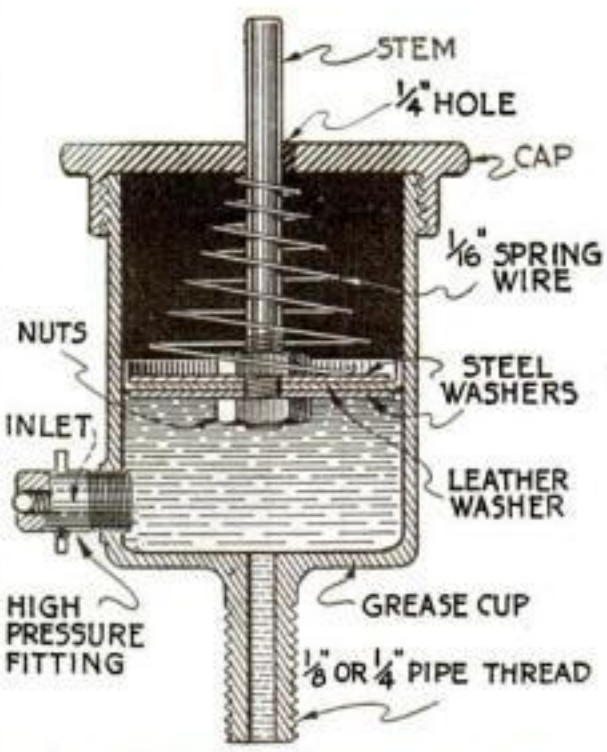
Now that you have completed the *Bluenose*, what type of a ship model would you like to build next? Among the possibilities are Admiral Farragut's *Hartford* (steam and sail), a modern destroyer (working or show model), a whaling bark, and an early American sloop.

Please send an expression of your opinion to POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York.

Automatic Cup Keeps Machine Greased

WITH the expenditure of a little time and money it is possible to equip your machines with self-feeding grease cups of the type illustrated.

The cup fits on the high pressure type of fittings and is filled by applying a high pressure grease gun to a similar fitting on the side of the cup. It is an easy task to keep bearings well greased if you have an automatic cup always on the job, supplying grease under pressure.



The self-feeding cup has a spring plunger that forces the grease into the desired spot.

The plunger consists of a leather washer held between two thin steel washers and two nuts on a ¼-in. stem. The spiral spring supplies the pressure by forcing the plunger face tight against the top surface of the grease. The stem serves as a guide to tell at a glance just how much grease there is left in the cup. When the cup is empty a high pressure grease gun is attached to the fitting on the side and grease forced in under pressure until the stem again reaches the proper height.

The grease used should be a soft easy-flowing mixture which can be made by adding a little oil to the commercial type of grease.

This type of cup is ideal for greasing such places as king-pins, auto rear axle bearings, auto fan spindle bearings, auto water pumps, and even auto spring shackles.—F. J. WILHELM.

Marking Straight Lines on Rough Surfaces

FIXING metal furniture leg slides to the guide of a marking gage will facilitate the marking of a straight line on rough wood.

The needle marker must be advanced as much as the guides project above the surface of the guide face. This will keep the graduations on the side of the marker accurate by counteracting the height of the slides.—R. B. WAILES.

Furniture leg slides are fastened to the marking face and the marking pin is moved forward.

Magical Spiritphone Answers Questions

By GEORGE S. GREENE

The completed spiritphone resembles a radio microphone with a receiver connected to it.

MAGIC fascinates most of us but often leaves us with the feeling that all good tricks are too difficult or complicated for us to attempt. The spiritphone illustrated, however, is easy to construct and still easier to operate, and is one of the most effective tricks for the amateur magician.

A slip of paper is passed to each person in the audience with the request that he write the name of some departed hero or famous man. The slips are collected and placed in a hat. The performer requests that one of the audience come up and pick a slip from the hat. An assistant is then instructed to go to the spiritphone and ask for the name written on the slip and repeat what he hears. The question is asked, and after a pause, the assistant says "Andrew Jackson," or whatever the correct answer happens to be. The slip of paper is unfolded and on it is written the announced name.

The accompanying illustrations best explain the mystery. By giving a fake screw a half turn with the finger nail, a disk inside the phone revolves, bringing into view a space with the name of the departed person on it!

The ear piece or receiver is, of course, a dummy made of wood. It and the connecting lamp cord have nothing to do

Wooden parts for spiritphone. Left to right, receiver and cord, box and base, disk, and cover.

with the actual operation of the trick.

The phone proper, having the appearance of a radio "mike," consists of a round box trimmed from a block of wood, an inside disk that turns on an axle, and a cover or lid with two windows apparently covered with fine mesh cloth such as is used on ornamental loudspeakers. The base is a circle of wood.

One side of the wood box is made slightly flat and is fastened to the base with two screws. Through the bottom of

The upper pencil points to the brad stop, and the lower to the flat flange on the fake screw.

the base and the box extends a fake screw with the end flattened. All but the fake screw on the bottom of the base is covered with felt.

A wire nail axle is fitted securely to the exact center of the inside of the box. Several washers are placed over it, and all is ready for the revolving disk.

One half of the thin wood disk on one side is covered with fine mesh silk cloth; the other half of the same side has a white card on which the name of the departed person is printed. With the disk in a vertical position and the white card at the bottom, a lead weight is placed on the other side at the top, and a small projecting brad at the bottom (the latter to engage with the flat end of the fake screw). The disk is then fitted to the axle in the box, weight side up.

The cover, which is merely a disk with two windows, as illustrated, is prepared by covering the rear side of the lower window with the same cloth used on the disk. It must match perfectly. The cover, with the open window at the top, then is fixed to the box with two screws.

It will now be seen that as the upper half of the disk is covered with cloth, it appears that both windows are covered with the same piece of cloth. In that lies the deception; for, by giving the fake screw in the base a half turn, thus releasing the brad on the back of the disk, the lead weight will fall and revolve the disk so that the white card is at the top window. Turning the phone upside down and again locking the disk with the fake screw will allow it to be examined without detection.

Now for performing: Print the follow-

The pencil points to that half of the disk which is covered with cloth to match the lower window.

At the bottom is the brad which stops the disk when it is in position for the printing to show.

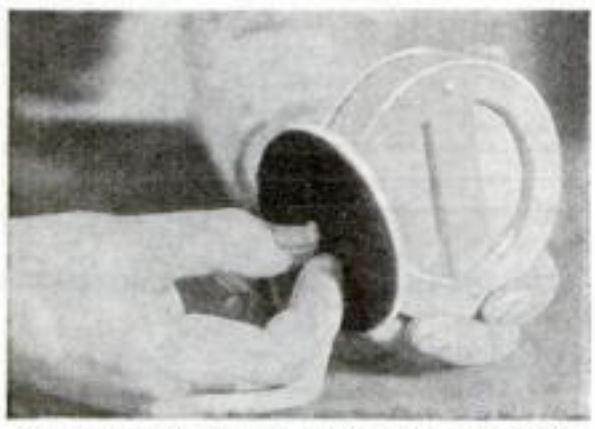
ing very legibly on the white card: "Please say 'Andrew Jackson.' Thank you." Reverse the disk and lock it. Cut a number of slips of paper and write on each "Andrew Jackson." Fold each to make a small packet.

Ask your audience to write names of departed persons on slips of paper which you furnish, and then fold them. The slips are collected in your right hand, while in the left are concealed the packet of "Andrew Jackson" slips.

Borrow a felt hat. It is held in the left hand, palm inside the brim, so that the "Andrew Jackson" slips can be nonchalantly dropped in without detection. Your right hand places the genuine slips inside the hat, but instead of dropping them, slips them underneath the sweat band.

Anyone can be asked to draw one of the slips after they have been shaken, it being certain that the choice will be "Andrew Jackson." Still folded, have the slip sealed in an envelope by any spectator without revealing the name to anyone.

After the spiritphone has been examined, place it on a table at the other side of the room, giving the fake screw a half turn as you do so. The audience can-



By turning the fake screw in the base of the phone with the finger nail, the weight is released.

not see the white card appearing in the upper window as the phone is turned in the other direction.

It matters not which spectator the audience selects to assist you. Ask him to walk to the table, sit down, and with the receiver to his ear to call "the land of the departed." He, of course, sees the name on the white card in the phone window and will invariably repeat it. When he has finished, say, "Thank you. You will not, of course, tell anyone how this trick was done?" Taken by the audience as a jest, at which they laugh, this remark is understood by your assistant quite well.

And not one time in a hundred will a spectator reveal his knowledge of the trickery. He is "in the know," and feels elated at having "put one over."

Combining a Window Seat and Chest

The chest seat can be made of hardwood or of soft wood painted to suit the surroundings.

BESIDES providing a comfortable window seat, the bench illustrated has an added advantage in supplying a roomy chest for the storage of books, sheet music, and clothing.

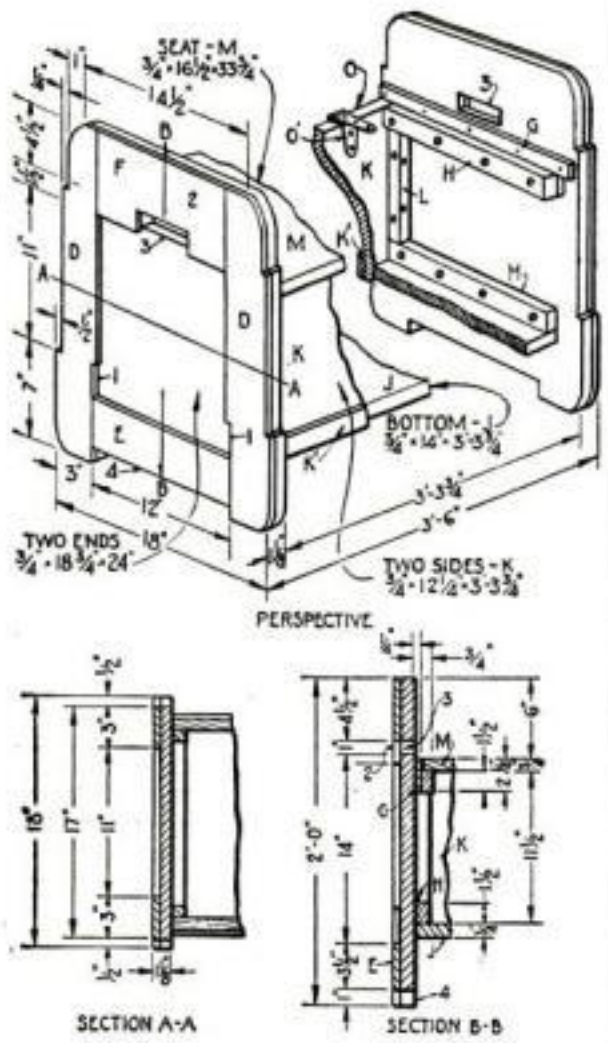
It may be made of any hardwood such as oak, ash, or mahogany to match other furniture; or of a more easily worked wood as red gum, whitewood, or white pine if it is to be painted or lacquered.

Make the two ends ¾ by 18 by 24 in.; four pieces *D* ⅜ by 3½ by 24 in.; two pieces *E* ⅜ by 3½ by 12 in.; and two pieces *F* ⅜ by 6 by 11 in. The grain of pieces *E* and *F* should run parallel to the grain of the end itself. Make pieces *D*, *E*, and *F* about ¼ in. wider to allow for fitting and trimming. Cut pieces *D* 1½ by 7 in. and the two handholes 1½ by 4 in. in pieces *F*. Plane and sandpaper the outside of the ends, fit pieces *D*, *E*, and *F* to make the end panel construction as shown, allowing the edges of *D* to project beyond the edges of the ends. Glue them in place and drive ⅞-in. brads through each piece to hold it while assembling the ends and placing them under the pressure of hand screws or weights that will force them to a joint.

After the glue has hardened, cut the handhole *3* through each end and cut out *4* to form the feet. Plane the ends of the top flush and lay out and cut the edges to the given form and dimensions, being sure that the cuts are square and true. This may be done on a band saw, if one is available. Smooth and sandpaper the entire end.

Make two cleats *G* ¼ by 2¼ by 16½ in. and two cleats *H* ¾ by 1½ by 14 in.; fasten *G* to each end as shown with ⅞-in. brads, sinking them below the surface. Place and fasten cleats *H* with 1¼-in. No. 9 screws. The bottom *J*, ¾ by 14 in. by 3 ft. 3¾ in., may be made of any wood, but the two sides *K*, ¾ by 12¼ by 39¾ in., and also the two moldings K^1, ¼ by 1¼ by 39¾ in., should be of selected wood, as these are conspicuous. Make four cleats *L* ¾ by ¾ by 8½ in., preferably of hardwood, and bore and countersink holes for a No. 9 screw as suggested. Fasten one of these with 1½-in. screws to the inside of each side at the end to fit

between cleats *H* as indicated. Smooth the face sides and assemble by fastening the bottom in place with sixpenny finishing nails driven into *H* as at *H-J* of section B-B. Nail the bottom edges of each side to the bottom and drive screws through cleats *L* into the end. Allow the end of the side to be a little under square so the screw will draw the side to a perfect joint with the end. Drive the finishing nails "toenail fashion" into the ends of cleats *H* and the ends of the chest. Smooth and sandpaper the molding K^1 and fasten it in place with brads. The seat or cover *M*, ¾ by 16½ in. by 3 ft.



Assembled perspective view of the bench and sections showing construction of the ends.

3¾ in., should be free from blemishes and twist or warp. Three cleats, ½ by 2½ by 13½ in., are fastened to the underside of the cover, two 2 in. from each end and the third in the middle. Fasten these with 1-in. No. 9 screws, placing five or six screws in each cleat after first boring and countersinking holes in the cleats for them. Fit the cover so tha the joint at each end will just clear cleat *G* and be parallel to it.

Fit two 3-in. strap hinges as at *O*, bending one half of the hinge to fit into the side, as at O^1, so that the cover will rest on the top edges of the side when it is closed. The hinge may be bent cold in an iron vise, or a brass hinge made for this purpose may be bought in any well stocked hardware store.

The completed chest may be finished in natural wood or stained to suit the surroundings. It should be given three coats of thin shellac, each well rubbed with 4–0 sandpaper followed with prepared wax and polished with a soft, lintless cloth. If preferred, a coat of good transparent varnish may be applied after the second coat of shellac and the high gloss removed with sandpaper and finished with wax as above.—CHARLES A. KING.

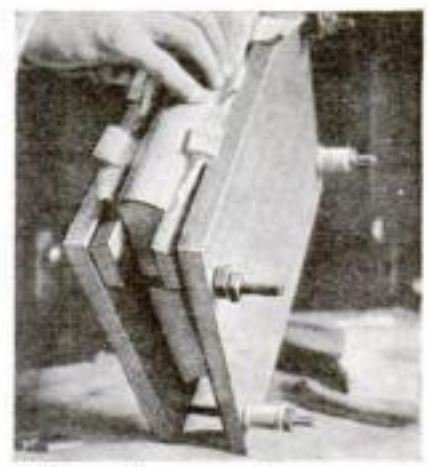
Issues of POPULAR SCIENCE MONTHLY bound in groups of six, making two volumes for each year. These form invaluable reference books.

Bookbinding Made Easy

By AUSTIN G. TRIBUTE

THE home workshop enthusiast who delights in books can quickly learn to rebind damaged or worn editions and make bound volumes of his magazines that will safeguard them indefinitely.

Let us take, for instance, six months of our favorite—POPULAR SCIENCE MONTHLY—and see how easily a bound book can be made. After removing the covers, draw out the wire staples and place the issues in the order they are to appear. Then separate the individual sections of sixteen pages each and scrape the glue away carefully with a dull kitchen knife.



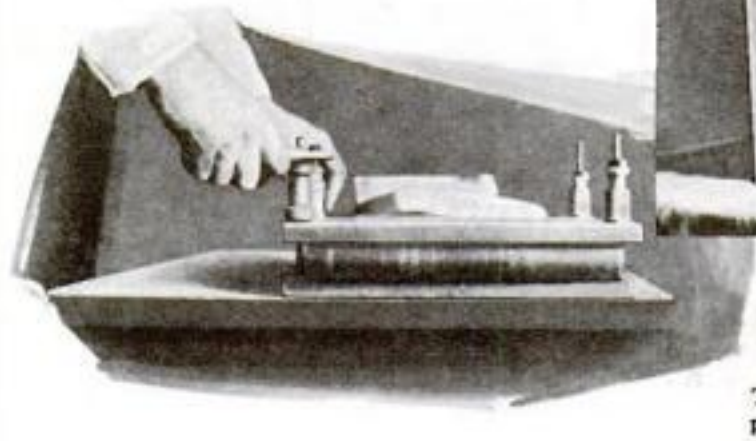
The sections spread fanwise and backed with muslin and paper.

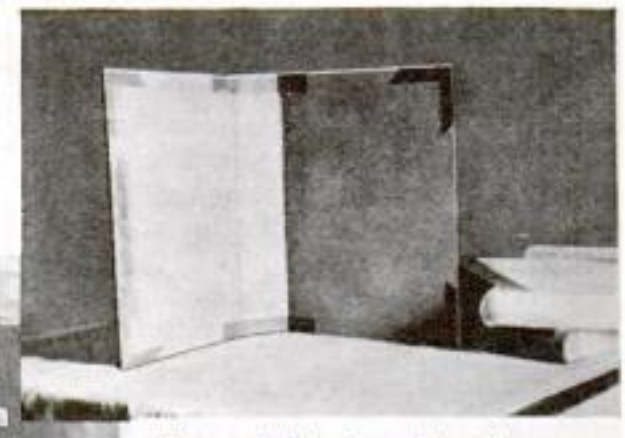
Make a sewing frame of some pine boards—a small platform with a perpendicular frame at one side as shown on page 113. Two, three, or four strips of 1 in. wide linen should be fastened at equal distances along the frame; the lower end of each is tacked to the base, and the upper end is tied to the frame with string.

With the sewing frame in front of you, place the sections on the baseboard. Note where the tape lies across the back of the sections and make a mark with a pencil on the paper at each side of each tape. Also draw a line down across the back of the sections about ¾ in. from each end. Take the sections from the frame, place thin boards along the sides but not quite even with the back, and clamp them tight. With a saw cut shallow slots at the pencil marks to facilitate the subsequent sewing.

Sewing is more easily done than explained. Place the last section face up on the baseboard of the sewing frame. Thread a needle with a reasonably long linen thread. With the left hand hold the section open—at the eighth and ninth pages—and pass the needle in through the cut near one end of the book. Grasp the needle with the left hand and pass it out at the side of the first tape. Carry it back again on the other side of the tape, and continue until all the tapes are fastened to the section by the thread. Let the end of the thread come out at the saw cut near the other end.

Place the next to the last section on the





The materials for making the covers can be bought in small quantities at almost any school supply house.

The finished volume is clamped in the press, where it is allowed to stay under pressure until the paste dries thoroughly.

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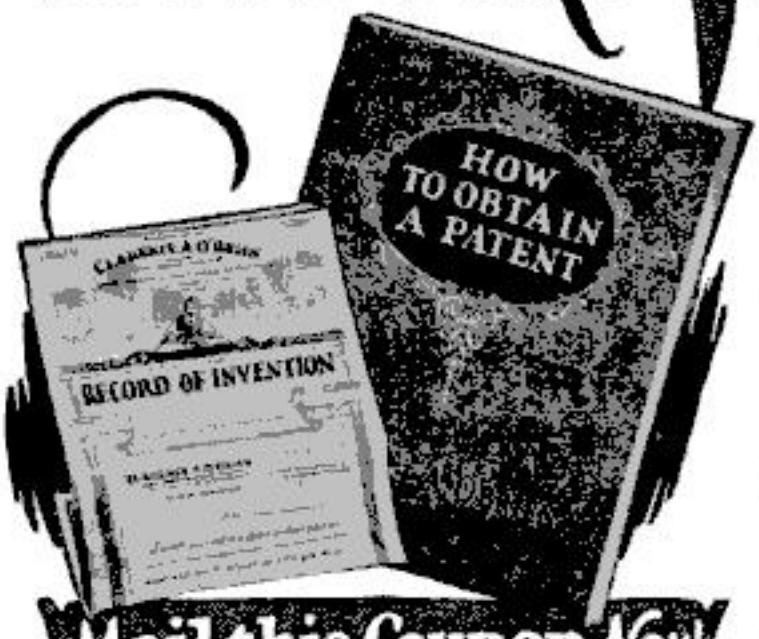

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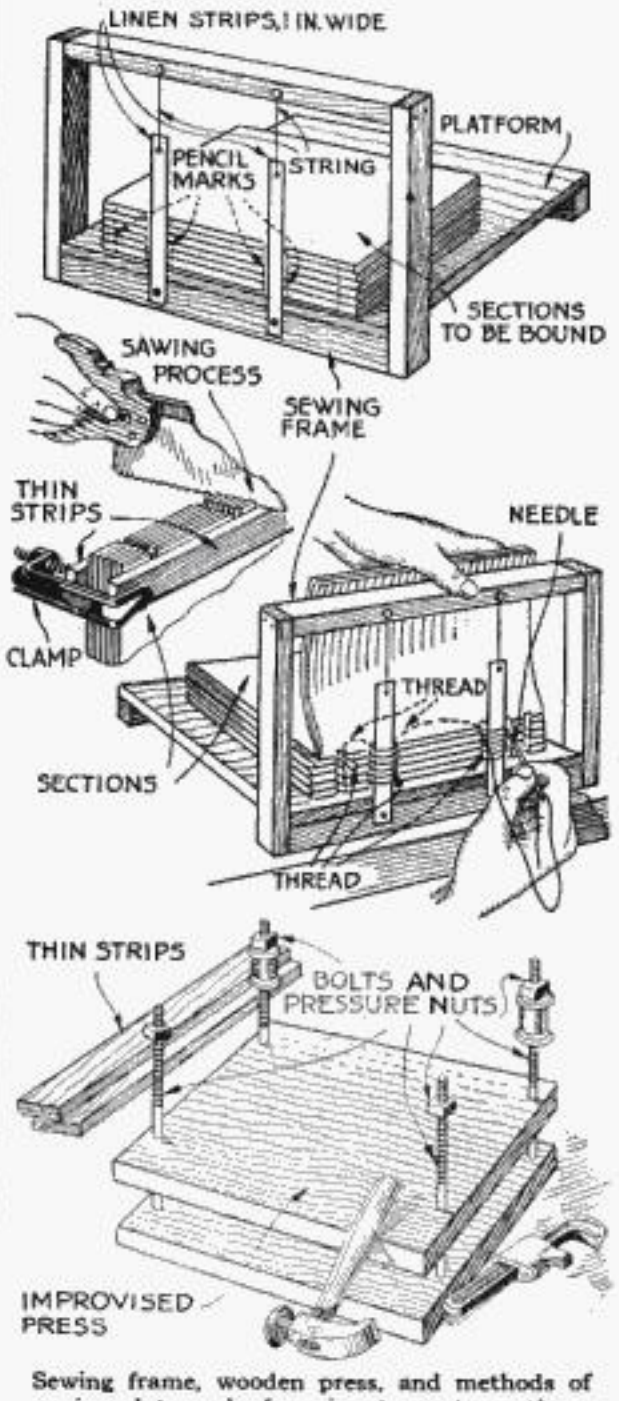
top of the one just sewed and continue as before. When the thread comes out through the last saw cut, tie it to the thread of the first section. The two sections are now held together. Repeat the process until all the sections are sewed to the tapes.

Remove the book from the sewing frame and trim the linen strips 1 in. from the back of the book. Apply the so-called end papers, which are four-page sections of blank paper folded and pasted on the top and bottom of the book ¼ in. from the sewed edges.

For a neat job it is advisable, at this stage, to have a printer trim the edges of the book in his cutting machine. The next step is to work liquid glue well into the back of the book so that the sections will adhere firmly to each other. When



Sewing frame, wooden press, and methods of sawing slots and of sewing tapes to sections.

nearly dry, form the back into a pleasing convex shape with the hands and with the light blows of a hammer. Let stand for several hours.

An improvised press should be made of two broad hardwood boards with bolts at the four corners. Place two narrow boards, one on each side of the book, with the back of the outer sections extending a trifle beyond them. Lower the book and boards into the press and screw the bolts up tight.

Spread the back fanwise with a hammer so that it appears round and has an overhang on each side. Glue a strip of muslin along the back, rub it well in, and follow

with two or three brown paper strips, glued on one at a time. Allow each to dry before putting on the next.

The cover or case, as it is called, may be made of heavy cardboard of one or more thicknesses and in any of several different styles. The covers shown have a backstrap and corners of bookbinder's cloth, and sides of strong manila wrapping paper. Make the case large enough to overhang the book about ¼ in. at the top, bottom, and side. Gage the width of the backstrap by the thickness of the book; and after it is cut, put on whatever lettering you wish.

Materials for making the case can be bought from school supply houses in the small quantities needed. Imitation leather, which can be bought in drygoods stores, makes a good covering.

When the case is made and adjusted to the proper position, open the front board and apply paste all over the top end paper and on both sides of the loose ends of the two or more linen strips. Drop the board—that is, close the cover—so that it adheres to the end paper, then open it up and rub the end papers free of blisters. Repeat the operation on the backboard and clamp the volume tightly in the press (without the narrow boards used before). When thoroughly dry, the book is ready for use.

Easy Ways of Removing Broken Set Screws

OFTENTIMES we are confronted with the not altogether pleasant job of removing a broken set screw. Aside from the unpleasantness of the job, it is usually difficult and presents somewhat of a puzzle as to the correct procedure.

When a set screw, holding a pulley in place or used in some similar part of a machine, breaks off, it invariably twists off close to or even below the surface of the threaded hole. If it twists off below the surface the question of successfully removing it sometimes seems almost unanswerable.

The following are kinks with which the writer has removed all sort of broken set screws without much difficulty and with only a small expenditure of time:

First, if the broken part projects above the surface, a slot can be cut in the top with a hack saw. Then a heavy screw driver bit is placed in a brace. The collar or piece of machinery is heated locally with a blowtorch or a piece of hot iron, and the screw is backed out while a helper taps the work firmly with a hammer.

If the set screw is broken off below the surface, the problem becomes a little bit different. With a center punch, mark the center of the screw and then drill a small hole, just a little smaller than a left-hand screw extractor or, in its absence, any suitable left-handed screw that you may happen to have. Place the left-handed screw in a brace and, turning it to the left, force it down into the drilled hole. The set screw can now be backed out if the work is tapped with a hammer. If carried out carefully, these methods will always prove to be successful in removing otherwise troublesome broken set screws.—H. W. SWOPE.

A definite program for getting ahead financially will be found on page four of this issue.

Small Bench Punch Aids in Cutting Odd Shapes

ASK any watchmaker what his most useful tool is, and nine times out of ten he will show you a collection of punches together with a G-shaped stand, the whole of which is usually known as a "staking tool."

The punch resembles a "staking tool."

With this design in mind, the writer made the device illustrated, and has found it well worth the time spent in its production.

The plunger, provided with a clamp or chuck at its lower end to hold the punches of various sizes and shapes, slides freely in the sleeve, which is held vertically in an adjustable clamping arm. The die is also adjustable in a slide in the base.

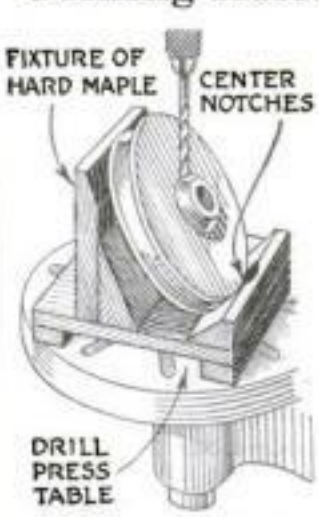
When the adjustments are made to bring the punch into alignment with the proper hole in the die, and the sheet stock is placed under the punch, a blow struck on the upper end of the plunger drives the punch through the stock into the die.

A soft rubber ring is placed between the supporting arm and the collar on the plunger to allow the punch to be withdrawn after it has done its work.

Eight simple parts are all that are used in the construction of this handy bench punch.

For cutting out irregular shapes, overlapping holes may be punched in rapid succession, an operation similar to that of a "nibbler." It will be readily seen that, for thin stock, this method is far quicker than the usual drilling of holes and filing out by hand.—W. N. C.

Drilling Holes at an Angle



Work held in jig at angle for drilling.

A FIXTURE for holding small pulleys, sheaves and similar work at an angle for drilling oil holes or set screw holes can be made from wood as shown. The foot piece is notched in the center to keep the work from moving sidewise. In shops where even a moderate amount of this class of work is handled, several such fixtures will soon pay for themselves.

"Patterns"—The New Psychology

(Continued from page 30)

some mental urge which has to be expressed in the course of life in order to bring normality and happiness. Other psychoanalytic schools have selected still other single mainsprings for the human motive power.

The one essential back of them all is the one-motive idea. Whether that one impulse is being released, thwarted, suppressed, sublimated, or otherwise disposed of explains all of the frequently unreasonable actions of mankind, the psychoanalysts urge, as well as the so-called reasonable ones. They contend that if the one ruling motive is denied reasonable expression, that may result in many kinds of mental or bodily disturbance; effects of "suppressed desires."

Psychoanalysis is merely a procedure by which the skilled psychologist may delve into the hidden part of his patient's mind, often called the "subconscious" or "unconscious" mind, and discover what has happened to the single human motive of sex or something else in that person's thoughts or actions; what "complexes," "inhibitions" or past experiences are suppressing or perverting some explosive motive which ought to be more safely released.

The Freudian ideas did not make their way in the scientific world without much opposition and argument. Hope of settling some of these arguments by actual experiment was one of the inspirations for the newer behaviorist psychology of Dr. Watson, a viewpoint which is still scarcely twenty years old. What people *say* about themselves, everybody admits, is often far from the truth. Why not try to discover the mainsprings of human nature, Dr. Watson asked, by examining what people *do?*

BEHAVIORISM began in the study of the psychological reactions of animals to various controlled conditions.

Similar tests can be used, Dr. Watson perceived, to test human beings. With very young babies, for example, it was discovered that fire, live animals, and similar things ordinarily regarded as dangerous and frightful do not cause fear. Only two truly human fears were discovered in these infants, fear of falling and fear of a loud, sharp noise. Behavioristic methods are still practically the only ones available, indeed, for study of the psychology of young infants.

As a philosophy, behaviorism implies that all human thought and action results from more or less mechanical and automatic reactions to external stimuli; like an automatic vending machine which always gives up the chewing gum when one inserts a penny. For the imagined captain in the conning tower, behaviorism substitutes a competent but will-less automaton. Whatever touches the proper stimulus gets the corresponding result.

To the argument between the Freudian, one-motive idea of a single mainspring controlling human actions and the older idea of many such controlling motives, the experiments of the behaviorists and others seem to have provided an answer. Neither opinion is right. It is now safe to say that human beings are not ruled by any one motive or impulse, such as sex or self-expression. On the other hand, the human mind certainly does not possess the vast series of complicated motives about which earlier psychologists talked.

The truth seems to be that mankind is swayed by more than one fundamental motive but only by relatively few, including self-preservation, desire for comfort, hunger, sex, and also such things as Dr. Adler's supposed mainspring of self-expression. Present knowledge is not sufficient to permit stating even a partial list of these psychological fundamentals, but it is possible to say that they are not so numerous as was at one time supposed.

What Horsepower Really Is

(Continued from page 76)

over faster and still develop the same turning force or torque. If you did all those things to the one-horsepower motor in the five-ton truck we were talking about, you'd make it go up the hill faster all right because the motor wouldn't be a one-horse motor any longer. Maybe it would be as much as two horsepower. Lots of auto motors rated at ninety to a hundred horsepower today have no bigger cylinders than the forty- and fifty-horsepower cars of years ago."

"I suppose that's why they rate gasoline motors at a certain horsepower at so many revolutions a minute," observed Joe. "Do those ratings tell how fast the motor will run?"

"Not at all," Gus explained. "All motors will turn over faster than the rate at which they develop the most horsepower. Only, when the motor speeds up beyond that point, the turning force drops off so fast that the horsepower goes down. It's like running a foot race. You get going about so fast and when you try to go any faster the muscles in your legs won't put any push into your feet."

"THEN that explains why different cars have different gear ratios," Joe commented. "Each one has a gear ratio that will let the motor run at the speed where it will develop the most amount of power."

"That's how they ought to be geared," said Gus. "Actually they're not. It's a sort of a compromise in most cases. Most everybody wants to be able to climb the side of a house in high gear and pull through the toughest kind of going without shifting. You can't have your cake and eat it, too, Joe, so if cars have to be made for people too lazy to shift gears, the manufacturers have to gear 'em lower than the best point for smooth, easy running, maximum speed, and best gasoline economy on level roads."

"Maybe that's why some of the cars are fitting four-speed transmissions," Joe suggested.

"Sure, but if a driver is too lazy to shift a three-speed transmission, putting four speeds in the box isn't going to cure him," Gus grumbled. "A real four-speed transmission would be ideal, but the ones they're fitting now are geared so low on high they really amount to a three-speed outfit with first speed reduced to an extra low gear that isn't any use."

"WOULDN'T that extra low first, if you had it in a hundred-horsepower car, make it pull like fifty pairs of horses?" Joe asked, again picking up the specifications of the car that had started the discussion.

"It might if it were low enough and you loaded the car with pig lead to give it traction," said Gus, sweeping the crumbs off the table into his lunch kit. "No matter how much power you've got or what the gear ratio is, you can get only so much pull before the back wheels of the car begin to slip. It sure would take a lot of weight to make two rubber tires grab the road like four hundred horseshoes!"

HAVE you some motor car problem that is causing trouble? Gus and Joe will be glad to answer any reasonable question on the subject of automobiles. Simply state your questions in a letter to Mr. Bunn in care of POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y.

Better Fuels for Better Motors

(*Continued from page 27*)

by the cracking process has still other characteristics.

The qualities of gasoline of most importance are its volatility, the ease with which it vaporizes, and its tendency to produce knocking. Gasoline engines designed up to a few years ago were built to compress the charge of mixed gasoline and air to as high a pressure as possible without producing knocking from ordinary distilled gasoline. But the efficiency of a gasoline motor rises rapidly with increases in compression. Automotive engineers have, therefore, long sought a means of eliminating the knocking tendency so that still higher compression could be used. Curiously enough, many types of cracked gasoline show a distinct antiknock tendency.

Experiments conducted at the Massachusetts Institute of Technology, Cambridge, Mass., (P. S. M., Feb. '29, p. 68), have shown exactly what takes place within the walls of the motor cylinder during a normal explosion. Observers, watching through a thick piece of fused quartz fixed in a plug in the cylinder, reported that there first appears the bluish light of sparks, then jagged flashes, and finally the brilliant glow of the gas explosion.

INSTEAD of burning in this orderly and progressive fashion, a knocking charge literally explodes. The knock is caused by the improper burning of the charge of gasoline and air. The flame front, which starts at the spark plug, advances with lightninglike rapidity through the entire charge and therefore sets up a peculiar local high pressure effect and vibratory motion.

Several methods have been found for combating the tendency to knock. One is to adjust the proportion of straight distilled gasoline so that the fuel will have the best possible natural antiknock qualities. Another way is to shape the contour of the explosion space in the cylinder—the cavity in the cylinder head into which the gas is compressed—in various peculiar shapes so that the flame of the burning charge is prevented from spreading too rapidly.

The third method has been to add some other chemical to gasoline to control the rapidity with which it will burn. Many different chemicals have a tendency to reduce knocking. Iodine is one, ethyl iodide another. The best so far discovered is tetra ethyl lead. Most of the other chemicals are unsatisfactory because they are too expensive when used in the proportion that will produce satisfactory results. Some are erratic in action.

FOR more than a year Charles F. Kettering, chief of the General Motors Laboratories, and a corps of assistants, conducted antiknock experiments which led to the discovery of Ethyl gasoline (P. S. M., Sept. '29, p. 32). They sought to produce an antiknock fuel by adding chemicals to the gasoline. They tried iodine, aniline, selenium, tellurium. And each attempt was a failure, or only a partial success. At last, Kettering suggested the use of lead, which was about the last thing chemists would ordinarily regard as helpful. When a fluid compound of lead was added to the gas, it knocked worse than ever. Then, Kettering reduced the proportion from one percent to half of one percent. The knocking diminished. The proportion was cut to one third of one percent. The knocking disappeared entirely.

Tetra ethyl lead, although poisonous to human beings or animals if inhaled, is absolutely harmless to any part of a gasoline motor. In cheap gasolines there are impurities which cause corrosion to the iron and steel surfaces. When tetra ethyl lead is used with such gasolines, corrosion may result, but if it does, it is caused by the harmful components of the gasoline (*Continued on page 140*)

Better Fuels for Better Motors

(Continued from page 139)

never by the tetra ethyl lead in the fuel.

A theoretically perfect motor fuel would have no tendency to knock no matter how high the compression and it also would vaporize instantaneously even in the coldest weather. No motor fuel now available will measure up to this theoretical ideal. Motor fuel advertised as "zero knock rating" is not really knock-proof in the true sense of the word. A zero knock rating gasoline or motor fuel is merely a motor fuel that will equal in performance, as far as knock is concerned, a standard fuel used by the manufacturers of tetra ethyl lead in working out the standard gasoline-ethyl-fluid blend. Of course, a zero knock rating gasoline would perform excellently in any standard engine made today as far as knocking is concerned. Although the knocking tendency of a gasoline limits the efficiency of a gasoline motor when operated with the throttle wide open to obtain full speed or full power, it is of trifling importance as compared with the ability of the fuel to vaporize quickly under normal driving conditions.

THE quickness with which the best grades of gasoline will vaporize was shown, a year ago, during the endurance flight of the Army monoplane *Question Mark*. One of the men was severely "burned" by the high test gasoline which sprayed over him as the refueling hose from the "nurse ship" was jerked out of his hands by a gust of wind. What really happened was that the gasoline vaporized so rapidly the temperature of the skin where it stuck was reduced below the freezing point.

It is entirely possible to produce a motor fuel consisting of a mixture of distilled gasoline, cracked gasoline, and, perhaps, tetra ethyl lead, plus relatively higher percentages of heavy, hard-to-vaporize fuel. The resulting mixture may give excellent results as far as knocking is concerned. Yet it will be very unsatisfactory for ordinary use in an automobile.

The relatively small percentages of high test, quick-vaporizing gasoline may give normal easy starting, but the heavy dregs of fuel that do not vaporize will cause excessive crank case dilution and, in consequence, excessive wear on the motor. So-called "bootleg" gasoline frequently is of this type; and in addition to its tendency to cause crank case dilution it may also contain an excessive amount of sulphur or other deleterious impurities left by careless refining methods.

Modern developments in the production of better motor fuels have made possible great advances in the design of gasoline motors. Engines made today use compression ratios that were considered impossible, or at least impractical, just a few years ago.

The development of the automobile engine has by no means reached the point where no further improvements may be expected. Chemists will produce still better motor fuels and these, in turn, will make possible the development of still more efficient and satisfactory automobile motors. The automobile engine of ten or twenty years from now may indeed be so far advanced that present ones will appear crude by comparison. And in this advance, one of the most important factors will be new and improved gasolines.

Cleaning Concrete Floors

AN EFFECTIVE cleaner for removing oil and grease spots from concrete driveways and garage floors is tri-sodium-phosphate, similar in appearance to common table salt. Wet the concrete thoroughly, then sprinkle the chemical evenly over the spots and let it stand for several hours. Then scrub the concrete with a stiff brush and wash it off with water.

New Help for the Hard of Hearing

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and uncompromising to the hard of hearing.

But are there no mechanical or other aids to deafness? Countless ear devices have flooded the market in recent times. A committee of medical men appointed several years ago by the American Federation of Organizations for the Hard of Hearing found that of the seventy-five instruments offered for use the old-fashioned horn was best suited for some stages of deafness. Membranes replacing the eardrums, electric amplifiers, and similar contrivances all have their advantages. But they have their dangers as well, and should not be used without the endorsement of an ear specialist.

A RECENT field which has been opened is that of the "teletactor," an invention of Dr. Robert H. Gault, who has been working under the auspices of the National Research Council. Following out the theory that hearing, in the last analysis, is really only "feeling" (the ear thrills to sound waves just as the body to waves of the ocean), he has evolved an instrument which, vibrating against the patient's finger tips, has enabled many to differentiate the air vibrations caused by words to such an extent that they can understand whole stories without even seeing the speaker. The instrument has increased the efficiency of lip readers thirty to more than 100 percent. In the deaf, the touch center develops and invades the hearing center. The deaf have a sense of vibration, enabling them to dance to music which they feel through the floor.

Another aid for the deaf is the "voice picture" apparatus. By this a deaf person can see a graph of his own voice screened simultaneously with that of a hearing person speaking the same words. The deaf person thus can learn the control of his own inflections, and is also aided in lip reading.

The importance of lip reading for the hard of hearing and deafened cannot be overestimated. It is a real salvation, and not as difficult as one might suppose. There are only fifteen visible movements to master to lip-read English speech. Although developed in America in private schools, lip reading now is taught in public evening school classes in about fifty cities in the United States.

WITH the advent of the talkies, many of the hard of hearing sent petitions to Hollywood begging directors not to abandon entirely the silent pictures. In answer to these entreaties several theaters have installed special equipment that enables the deafened to hear nearly all of the new sound effects.

But such attempts to salvage the pleasure vehicles of the modern world for the hard of hearing are in vain unless the sufferers are willing to face the facts of their condition in an open-minded way. Some time ago I suggested the possibility of a rest cure for the tired or inflamed ears in much the same fashion that we prescribe rest cures for sick eyes and muscles. The lack of completely soundproof rooms, however, has forestalled extended studies in this direction. One thing the hard of hearing should always remember is that any general debility always attacks the weakest organ first. For that reason good health should be one of their greatest concerns.

Miss Estelle E. Samuelson, in charge of an advanced class in lip reading at Columbia University, said recently: "Hearing people have no idea of the misery which comes from the uncertainty of knowing what others are saying. When we learn to read lips, however, we are brought back to the normal world."

The normal world! That is the rightful heritage of every individual, and not until parents and educators coöperate to the fullest extent can deafness be prevented and damaged hearing be improved.

Sailing Faster Than the Wind

(Continued from page 32)

sie, N. Y., and Hyde Park, a few miles to the north, were focal points of the most scientific ice yachting in the East, but the sport has vanished there because ice breakers keep the Hudson River open. The center has shifted to the north and south Shrewsbury Rivers in New Jersey and to Pleasure Bay in the same state. In the Middle West there are fewer ice boats, but the clubs are better organized. The Northwest Ice Yacht Racing Association stages championship races every year.

Primarily, ice yachting is an amateur sport. Commodore Weaver of the Red Bank Club is a splendid example of the devoted ice-yachter and of his competitive spirit. Past his seventy-sixth year, he has been an ardent ice contestant since 1872. The Commodore has spent virtually all of his adult life striving to win the Ice Yacht Challenge Pennant of America. Up to date it has remained with the Hudson River boats, although the Shrewsbury River craft have finished a close second many times, the Commodore's boat having just failed to grasp it on several occasions. At seventy-six, he still hopes to sail the winning boat.

WHILE the most elaborate speed yachts, constructed with selected lumber, sails, and fittings, may cost as much as $1,200 to $1,800, the expense of building an ordinarily good ice boat is moderate. Any man with fair skill in the use of tools can build one, though of course specialized knowledge is required to design a pennant winner. The art of sailing an ice yacht, however, is not so easily acquired. Piloting a craft at high speed along a river scarcely a mile wide demands the utmost skill, and yet so well does an expert have his craft under control that he can, as a rule, round a stake within six inches of it. It is not quite true that any one who can sail an ordinary sailboat can sail an ice yacht. To know just when to jib or go about in an ice yacht and get the most speed and distance out of her takes practice. Because there is less resistance to turning on the ice than in the water, an ice yacht spins about much more easily. Hence the shape of the sail tends rather toward height than width. For the same reason, the sail is kept close-hauled. If the sailor lets go his sheet and allows his boom to swing out sailing before the wind, as he would in a sailboat, he will find himself spinning about in circles. Also, if he tries to go about too rapidly he will spin around with a jerk and likely be thrown from his cockpit.

BUT the ice yacht is withal an extraordinarily safe affair. Elderly men who have followed the sport all of their lives say there is little danger. Few are ever seriously hurt. One may have a bit of skin scraped off by being thrown out on rough ice, or may suffer a few bruises, but there are few instances of broken arms or legs on record.

The only situation that causes real anxiety is that of an ice boat runaway at a race. In a sudden flaw of the wind the crew may be thrown out and the yacht left without a master. The craft darts hither and yon on the ice, and woe to any one who gets in the way of it! And it's hard to catch. Occasionally, before it can be controlled it smashes up several other boats and knocks over a dozen people.

Ice yachts have undergone a marked evolution in design since their origin in pre-Revolutionary days. The original scudder was a big, shallow box mounted on four rigid runners. An ordinary mast and sail were used, and a pike pole for steering. Later the aft runners were mounted on pivots and used for steering, but they were unhandy and cumbersome. Then some inspired designer reduced the two steering runners to one, a vast improvement. The first runners were made of skates, and some of hoop iron, but these were supplanted by specially constructed soft castiron runners. After a time the four-runner box boats were succeeded by triangular-shaped affairs of skeleton construction.

The improved design of the modern yacht involves a groundwork of two pieces—a center timber and a crosswise runner plank. The center timber, on which the mast is stepped, runs fore and aft, its forward part constituting the bowsprit and its after part holding the box for the helmsman. The runner plank tapers toward the ends, on which the runners are placed. The center timber rests upon the middle of the runner plank at right angles, and is attached to it by a gammon iron. Stays secured by turnbuckles lead from the ends of the center plant to the runner plank. The mast is secured by shrouds leading down on each side to the runner plank, and by a forestay leading to the outer end of the center timber. The yacht rides on the runners and the rudder, the latter extending down from the helmsman's box on the after part of the center timber.

THE first yacht of this type on record was constructed on the Hudson River by Edward Southwick of Poughkeepsie, N. Y., in 1833, although he made runners of ordinary skates. From that time on improvements were made steadily. The *Icicle*, the largest ice yacht ever constructed, was built in 1869 by John A. Roosevelt of the Poughkeepsie club. It was sixty-eight feet long and carried 1,070 square feet of sail. At present most ice yachts carry about three-hundred and fifty square feet of sail.

After the Civil War scientific principles were embodied in ice boat construction, and in 1879 the *Robert Scott*, built by Herman Relyea, the pilot of a river steamer, defeated the *Icicle*, which carried twice as much sail. An important improvement lay in stepping the mast forward of the intersection of runner plank and keel, thereby making the center of sail effort agree with the center of hull balance. Thereafter the tendency was toward smaller yachts, because they were easier to handle and did not require as thick ice.

ANOTHER addition to efficiency of design was the discovery of how important wind resistance is in slowing down the speed of a craft. As a consequence side bars on runner planks and rope rigging were replaced by wire, reducing resistance considerably. When the larger boats of the early days were sailed a crew of five or more was required. One man usually clung to the shrouds at each end of the runner plank, while another shifted from one side to the other as his weight was required to hold down the windward runner. Even then the pressure on the yacht would often lift the windward runner with its burden of two men high above the ice.

In the actual construction of an ice yacht, the essential points are to make the boat light and strong, with a runner plank of considerable elasticity and a sail area proportional to the size of the boat. Some owners carry two sets of runners—a sharp V-shaped set for skimming over hard ice, and another more or less dull set for use on soft ice. The canvas should be as light as possible.

Ice yachting promises to become an increasingly popular sport in America. There is a movement afoot to combine the clubs throughout the East into an Eastern States Racing Association for the holding of annual championship races. The boatmen of the Shrewsbury, and other sections where the sport flourishes, say they will be glad to help and advise all who are interested in their hobby. And the chances are they will be kept busy.

A Revolution in Plumbing

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for it can be drawn through walls and partitions without damaging them or tearing up the floors to any great extent. Other advantages of copper tubing are its resistance to corrosion and its ability to swell without cracking in the event of a freeze.

While supply pipes are always filled with water under pressure, there is no pressure in the waste pipes. They are so placed that they empty themselves immediately; consequently they can be made of any material that is permanently tight. To prevent sewer gas from seeping in through the waste outlets, each fixture is provided with what is known as a trap—a pipe or fitting so formed that it retains a small quantity of water that seals the passage. A connection to an air vent in the roof is required to keep the trap properly filled; otherwise the water will be sucked out by the partial vacuum formed in the waste pipe as a result of the downward rush of water.

WHILE the quality of fixtures somewhat determines the cost of a plumbing system, the price is affected even more by the design and layout, and by the labor required. If, for instance, there are bathrooms at both ends of a house and the kitchen is in the center, each must be provided with its own waste and supply lines; but while the water supply pipes can be carried anywhere, the waste pipes must rise vertically from the cellar. Much material will thus be required, with a corresponding charge for labor. By putting the two bathrooms side by side above the kitchen, one line of waste and water pipes will serve for all three, and costs will be greatly reduced. Thus economy in a plumbing system demands that all runs of pipe be short and direct.

Because of present-day shortage of help and the development of the neighborhood laundry, home laundry equipment is not so prevalent as it was a few years ago. Many of the new houses have but one laundry tub, which is combined with the kitchen sink. This is a deep compartment at one side that can be covered with a metal plate that serves as a drain board. In another form the kitchen sink is combined with an electric dishwasher. This machine is not only practical but a marked saver of labor, for at the end of the washing the dishes are so hot that they dry by themselves and do not need wiping.

NO PLUMBING system is complete without an ample supply of hot water, and the favorite source is an automatically heated storage tank. The usual fuel is gas, with coal or kerosene oil as alternatives. During the cold season the steam or heating plant can do the work, a small cylinder being attached to the outside of the furnace and so connected that it is filled with hot water from within. It contains a coil of copper pipe connected to the storage tank, and the circulation established will provide all the hot water needed. With an oil-burning heater this plan can be used the year around, a device attached to the heater preventing it from reaching a temperature that would warm the radiators, but which is sufficient to supply hot water. So little oil is consumed that the cost is negligible.

A plumbing system that is poorly designed or installed is considered to be so great a menace to health that progressive communities are adopting codes specifying the designs, materials, and methods that are considered safe. In districts that have not taken such action, safety can be assured by following the rules which are laid down in a pamphlet issued by the United States Department of Commerce under the title of *Recommended Minimum Requirements for Plumbing*. This set of rules can be obtained for thirty-five cents from the Superintendent of Documents, Washington, D.C.

Shall Speed Laws Be Abolished?

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for the country as a whole, the increase was twenty-nine percent over 1924. The difference is largely explained by the rising figures for fatalities in the rural areas."

A secondary aspect of the situation revealed by Dr. Dublin was that speeding is primarily an indulgence of the younger and more adventurous generation of motorists. His figures for New York State showed that fifteen percent of the junior operators who became involved in automobile accidents caused a death, while of the more experienced drivers thus involved only three percent caused a fatality.

On the basis of these facts, the Commissioner of Motor Vehicles has severely restricted the licensing of junior operators in all sections of New York State. As a result, the number of deaths from accidents in which junior operators figured has been reduced from fifteen to seven percent. An analysis of these accidents shows, incidentally, that reckless driving or speeding was present in virtually every case.

THE insurance expert's facts and figures demonstrate conclusively that no solution of the speed problem is possible without taking the safety question into account.

Much can be learned, in this connection, from the experience of older forms of transportation which have grappled with the same double problem. To find out how the railroads consider the problem of speed in relation to safety, and whether railroad ideas might profitably be woven into a solution of the automobile speed problem, we consulted J. J. Pelley, President of the New York, New Haven & Hartford Railroad Co. This executive made the following significant statement:

"While the principal factors in satisfactory passenger transportation are safety, comfort, regularity, and speed, the safety and comfort of passengers and regularity of service cannot at any time be subordinated to a desire for speed."

Railroad speeds, he told us, have not been increased materially for the last thirty years. Recent emphasis on the effort to hold and recapture dwindling passenger revenues has included speeding up of the service.

The railroads have spent millions of dollars on such improvements as heavier rail, stone ballasting, changes in alignment, elimination of curves, more and longer passing tracks, and new systems of signaling, including automatic train stops. They have bought new, heavier, and improved equipment, permitting more extensive operation of all-steel passenger cars. In some instances these innovations have resulted in faster schedules without sacrifice of comfort or safety. In addition, a number of railroads have organized subsidiary bus lines which sometimes replace train service and eliminate stops at smaller stations. Every stop eliminated means faster schedules without an increase in operating hazards.

"AT THIS time, however," continued Pelley, "it is impossible to foretell accurately how far the move for greater speeds will be carried on the railroads. I believe it is safe to predict that no revolutionary changes will be made in the near future, since it is well established that unless conditions are ideal speeds greater than sixty-five or seventy miles an hour are not comfortable.

"But it must be borne in mind that any measure of speed of trains with safety is possible only because railroad traffic is controlled, coördinated, and directed by skilled and experienced engineers and other personnel operating under definite, comprehensive, and uniform rules. That personnel is greatly aided by modern signaling and a multitude of other mechanical devices which to a large extent remove the danger of failure in the human element."

There is the rub so far as automobile speeds are concerned. If the railroads, with the finest and latest equipment obtainable, operating on exclusive right-of-ways over perfectly level, smooth, steel rails, find that they cannot operate trains at speeds of seventy or even sixty-five miles an hour so that they will be comfortable to passengers and give a reasonable guarantee of safety, how can higher speeds than that become common for automobile touring? The only factor that would make them possible would be highways of the type suggested by President Williams of the Marmon Company. But these would, in effect, amount to practically smoothly paved "railroad" right-of-ways. In fact, this element of improved roads recurs in every discussion of the auto speed problem.

The first plank, then, in POPULAR SCIENCE MONTHLY's Speed-with-Safety Platform is:

MORE roads, wider roads, smoother roads, and safer roads. On that point, we feel sure, there can be no argument. Almost every motorist must agree with the leaders in the auto industry that the speed laws as now written and occasionally enforced accomplish next to nothing. The trouble is not that there are such laws, but that the speeds they provide always are set according to some arbitrary limit which hardly ever takes actual road conditions into consideration. Therefore, as point number two in our plan, we propose the abolition of the speed laws as now written. In place of these laws exhaustive tests should be made, followed by the posting of all roads with the speed at which traffic must travel. At the beginning of a long, straight stretch without intersecting roads, for example, a sign should be posted specifying whatever rate high-speed tests have shown to be safe. This might conceivably be forty, fifty, sixty or even 100 miles per hour. At the end of the straight stretch there should be another sign with another posted speed found suitable for the curving grade at the end of the straight stretch, and so on. By posting the highways, as suggested, with scientifically figured speeds, motorists would not be tempted to exceed the limit as now.

As pointed out by President Miller, of the Willys-Overland Company, speaking from the point of view of the automobile manufacturer, and by Dr. Dublin, representing the insurance business, passing cars is one fruitful source of accident. Thus we propose, as point number three, that cars be prohibited to pass each other or even to attempt to do so when proceeding in the same direction.

THERE would be no chance to enforce this provision, of course, if cars were allowed to go at any speed desired below the maximum posted speed for the particular stretch of road. Hence, point number four would make it illegal for any car to operate on the road at less than the posted speed. Obviously, if the car ahead is traveling at the legal speed limit and that limit is known to be just as high as safety will permit, there is no incentive to pass the car in front.

This suggestion, by the way, is not as novel as it may seem. A motorist who, for instance, attempts to drive from New York City to New Haven, Conn., on the morning of the day of a big football game at Yale, will find himself instructed—often none too gently—to "keep moving." Likewise, anyone trying to saunter in his car up or down Fifth Avenue, in New York City, during the rush hours, is likely to become the unhappy recipient of a ticket for blocking traffic.

Point number five of our proposed scheme is the logical complement of points three and four and is, moreover, (Continued on page 148)

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scientifically justified. It is a recommendation to regulate the distance between cars in accordance with the speed at which they are traveling.

In this connection, too, scientific tests should be made to determine just how far apart cars should travel for maximum safety consistent with a reasonable use of the road at various speeds. The prescribed distance between cars should be posted along with the speed, and would naturally change with each change in the speed rate. Every car would be compelled to maintain the legal distance between itself and the car ahead—no more, no less.

Finally, point number six is based upon plain common sense. Every car in use on the road, regardless of whether it is two weeks or ten years old, should be carefully inspected by someone who knows his business at stated intervals to make sure that it is in proper mechanical condition.

We are convinced that the foregoing plan, if carried out, would greatly increase the average motoring speed over any given route, largely eliminate all of the prevalent sources of accident, and rid motoring of its most annoying features.

It would curb the road hog, either train or rule out the dawdling incompetent, and afford the sane and reasonably experienced driver the legitimate privilege of traveling as fast as safety scientifically permits.

It would, in brief, restore the joys of the highway to all those who are entitled to them.

Kill Insect Pests with Short Wave Radio

FLIES, cockroaches and orchard insect pests killed by radio is a new marvel announced by the New Jersey Agricultural Experiment Station at New Brunswick, N. J. Recently Dr. Thomas J. Headlee, entomologist of the station, demonstrated how insects placed in a glass tube and exposed to powerful radio waves from a high-frequency transmitter, died in a few moments. The short waves, of twenty-four meters wavelength generated heat within the bodies of the insects and killed them. The experimenters say that eventually radio may be used to fight insects in orchard and field—and perhaps in the home, too, to slay flies and other pests.

That such experiments have already been made elsewhere was recently revealed when the Federal Radio Commission ordered a hearing to determine whether "radio bug-killers" operated by a Seattle, Wash., corporation created static and interfered with broadcasting reception. Seven-thousand-watt transmitters with which this concern claimed success in eradicating fruit insects at Cashmere, Wash., and elsewhere, have been ruled by the commission to come under regulations for broadcasting stations.

Search for Inca Gold

INCA gold, believed to have been hidden for nearly four centuries, is being sought in a high pass of the Andes Mountains, just north of Peru, as the result of a recent accidental find by a party of prospectors. A cave containing ancient skeletons and an Inca idol, symbolic of the sun, suggested that the region may contain the fabled gold and jewels, valued at $15,000,000, which were collected to ransom the last Inca king of Peru, Atahualpa, from the Spanish conqueror, Pizarro. The king was strangled by the conquistadors and the Incas are said to have hidden the collected gold and jewels in a mountain cavern. Near the pass where the cave was discovered, the Inca warriors fought one of their greatest battles four and a half centuries ago.

Back of the Month's News

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Dr. Hibben also studied autumnal colors of foliage with the same instrument.

While this expert was finding the way the colors were blended, others have been tracking down the source of the colors themselves.

Copper and iron, pigments and optical illusions—these are the stuff from which birds get their brilliant plumage and butterflies and flowers their rainbow tints. Many an African bird literally carries a coat of metal on its back. And the blue of the familiar bluebird is an illusion, for the bird is really orange.

Chemists have succeeded in analyzing very few of Nature's colors. It takes so little pigment to color a bird, for instance, that by the time they have removed the impurities from the color there is little left to analyze. But they have been able to extract metallic copper from turacin, the reddish-purple color of such African birds as the Touracoes and the Cape lory. These birds fade to a pale pink in the rain, but their color returns when they dry. The only green pigment known to exist in bird feathers, found in the plantain eaters, contains iron.

In the vegetable world, a pigment that has been isolated, crystallized, and purified is carotin, the carbohydrate substance largely responsible for the yellow colors of autumn foliage. They have found that the familiar green substance, chlorophyll, that gives foliage its summer tints probably turns red in the fall because of alcohols produced by fermentation, perhaps much as alcohol colors a drunkard's nose. Most of Nature's pigment colors are traced to "lipochomes" or fatlike substances producing red, yellow, or greenish hues, and "melanin" pigments giving darker tones such as black, brown, and gray.

But some of Nature's most striking colors are not due to pigment alone. They are real optical illusions. Thus the bluebird owes its color to an orange or brownish pigment in the feathers, plus a surface layer of colorless transparent cells that act like glass prisms and give by diffraction an outward appearance of blue. Most birds with green plumage derive the coloring from yellow, orange, or grayish pigment with a coating of the same refracting bodies.

Beer 5,000 Years Old

WHAT sort of beer the Pharaohs drank, whether it was light like Pilsener or dark like Münchner, has been determined precisely by Prof. Johannes Gruess of Berlin. Taking to his laboratory a consignment of Egyptian jugs and bottles dating as far back as 1,700 years before King Tut, sent by H. E. Winlock of the Metropolitan Museum in New York City, Professor Gruess subjected them to severe analysis. The jugs were found in tombs, and originally held liquors supposed to speed the kings on their journey to Paradise. The liquor had long since evaporated, and nothing was left in the bottles except dried yeast deposits. An expert in yeasts, Professor Gruess was able to determine the special kind of beer which the bottles held from the starch grains mixed with the yeast deposits. If the Pharaoh was addicted to wine, it could be told from the presence of acid crystals in the bottle.

Apparently the Egyptian brewers and wine-makers were not bothered by excessive cleanliness, and did not strain their water. Twigs, leaf fragments, water weeds, the wings and legs of insects, and even desert dust—all were discovered by Professor Gruess along with the other ingredients of the jugs. But they were careful about their yeast, the professor claims, for their cultures have kept pure through thousands of years.

The professor's analysis failed to find evidence of the use of distilled liquors among the Egyptians.

Meeting Emergencies in the Air

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cool before reaching the ground, when there is likelihood of a crash.

Only once have I had a motor catch fire. That was enough. A new Fokker pursuit ship, with a Mercedes motor, had arrived at our army field in Macedonia. As test pilot, I tried it out. It could zoom like a rocket. I climbed it to the ceiling, over 15,000 feet. With the motor hot, I came down blimping the engine on and off to keep it from fouling up. As I gave it one shot of the gun, black clouds of smoke suddenly streamed from the engine. The carburetor had ignited. The motor was aflame, 10,000 feet in the air.

The first impulse in such an emergency is to shut off the engine. The opposite should be done. I cut the flow of gas at the tank, slapped open the throttle, and dove. In an instant, the racing engine had sucked all the gas from the carburetor and the fuel line. The rush of wind past the plunging machine snuffed out the flame. At the end of a thousand-foot drop, I leveled off. Cautiously, I opened the fuel line. The motor caught hold, sputtered, roared. The fire was out; the danger over.

IN SOME cases, it is better to side-slip than to dive if the motor ignites. A steep slip blows the smoke and flame away from the cockpit and keeps the machine itself from catching fire. In a pusher plane, with the motor and propeller at the rear, the ship should always be dived so the flame streams behind away from the wings. If the ship itself begins to burn, the pilot should "bail out" with a parachute at once.

One of the first questions asked of new members of the mythical "Caterpillar Club", made up of those who have saved their lives by trusting to the silk of parachutes, is whether they brought their rings down with them. When the parachute ring is jerked, it brings with it a wire and pins, allowing the pack to open and the 'chute to blossom. Usually, in the excitement, the jumper drops the ring somewhere between the ship and the ground. A jumper who has the presence of mind to hang on to his ring is considered an "ace Caterpillar." To a certain extent, a parachute can be guided during the drop by pulling the ropes on the side to which you want it to swing. I once saw a jumper miss a tall chimney by clever "climbing of the ropes." But luck was against him. He landed right in a thorn tree.

DURING the war, we had no parachutes. We stuck to the ships. Sometimes they would stagger back from over the lines half shot to pieces. We would set them down as gingerly as though they were egg crates. We were afraid they would fall apart. Once I came down with two struts dangling and a hole in one wing big enough to stick my head through. In ordinary flying, a pilot rarely meets the emergency of a hole in his wing. But in severe hailstorms the fabric may be torn. To bring a ship through such a crisis, throttle down to the lowest flying speed and "drag" the injured wing. That is, fly with that wing low. In this position, it lifts less than the other wing and the strain on it is reduced. If the hole is so large that it cuts down the lift of the wing, tipping the plane to that side, the ship must be put in a spiral with the damaged wing at the outside. Here, it travels faster than the inside wing, its lift per square foot is increased, and the support of the two wings is equalized.

If an elevator control wire breaks in the air, a pilot can sometimes govern the up and down movement of his machine by means of the throttle. When a motor is speeded up, it tends to lift the nose of the plane slightly. When it is slowed down, it depresses the nose.

The other day, a (*Continued on page 148*)

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man from the Middle West came to Curtiss Field. He wanted a pilot to fly him low over New York and point out places of interest. He was surprised no one would go. It is sixteen years since I flew over a city. Never again. I had just learned to fly. I decided to give Sofia, my home city in Bulgaria, the thrill of its life. I skimmed only a few feet above the houses with my motor roaring. I circled the market square lower than the tops of the buildings. My life hung on the steady drone of that engine. When I landed at the flying field, one of the mechanics noticed gasoline dripping from a connection in the fuel line. He touched the connection and it broke in two. Throughout the flight it had been hanging, ready to break at the slightest strain. A forced landing low over a city leaves but one desperate chance. That is to pick out the largest roof, set down the ship, and slap it up against a chimney. This may break its momentum and keep it from plunging over the edge of the roof.

I USED to know a "dizzy" flyer who would come down for a landing with his ancient "Jenny" biplane upside down. At the south side of Curtiss Field, near the water towers, he would roll her on her back and sail half across the field hanging head downward. When less than a hundred feet from the ground, he would flip the crate over "on its feet" and make a three-point landing. But once he didn't. His decrepit kindling wood ship landed right on top of two brand-new cabin planes. It scrambled them both.

While there is little excuse for stunt flying at low altitudes, above 1,500 feet it should be part of every flyer's training. It gives him confidence. It teaches him to bring a ship out of a jam. If his plane slips into an unusual position in the air, he is not thrown into a panic. He knows what to do.

If a pilot is stunting above 1,500 feet and slips into a tail spin, he has time to get the ship under control before it strikes the ground. To do this, he makes three movements. He shuts off the motor, shoves the stick ahead, and kicks over the rudder in the direction opposite to that in which the ship is turning. Before every spin, a plane always gives a definite warning. The controls get "sloppy," move easily. This indicates the machine is losing flying speed and is about to stall. The faster a ship flies, the greater the resistance the stick offers to being moved. An experienced flyer can estimate his air speed accurately by the "hardness" or "softness" of his controls. It should become second nature for a pilot to point down the nose of his ship the instant the controls move loosely in the air.

BEING able to stunt probably saved my life in one of the strangest aerial duels on record. A new aircraft searchlight had been installed near our army field. To give the operator practice, I was to fly into the beam and then try to get out. I was circling around in the dark about 3,000 feet up when the searchlight below went into action. The beam felt along the sky and reached the plane. I was banked for a turn. The glare struck me full in the face, blinding me. I couldn't see the instrument board. I couldn't see how I was flying. I expected to go into a tail spin any moment. I zoomed. The beam followed. I dodged, side-slipped. The operator was too fast for me. The dazzling illumination seemed glued to the ship. Everything was blotted out by a glare that rivaled the noonday sun. Minute after minute this strange battle went on. Finally, in desperation, I came out of a loop with a sheer plunge of 900 feet. It might have washed off the wings. But it didn't. I fell faster than the (Continued on page 149)

Meeting Emergencies in the Air

(Continued from page 148)

searchlight could be lowered. Once out of the blinding light, I streaked for the air field. The operator had all the practice he would get that night.

In every loop, you see the horizon pass before the nose of the plane three times. As the ship zooms upward, the horizon drops past the nose. When the machine heads downward from its inverted position at the top of the loop, the opposite horizon flashes past. And when the plane comes out of the evolution at the bottom, the first horizon appears again. If the evolution is incorrectly performed, or if the machine has insufficient speed, it may hang upside down at the top until the wings "mush" down and the nose drops. Once I was looping a ship belonging to a friend. He weighed fifty pounds more than I, and his safety belt was several inches slack for me. At the top of the loop, the plane stuck and I half-dangled out of the cockpit until the nose dropped into the dive.

THE most difficult and dangerous stunt, one that only a handful of dare-devils have performed, is the outside loop. The machine makes a vertical circle with the wheels pointing in toward the center rather than away from the center, as in the usual loop. Centrifugal force, instead of holding the pilot in his seat, tends to throw him outward as a drop of water is hurled from a revolving grindstone.

Jimmy Doolittle made the first outside loop in 1923. Just after the war, in 1919, I attempted to make one in a Fokker D7. I had a special leather harness to hold me in the cockpit. It fitted like a letter "X" over my shoulders and chest. At 6,000 feet, I went into a vertical dive. The Fokker was hurtling down at nearly 200 miles an hour when I shoved the stick ahead. Then everything happened in a split second. Water, oil, and gasoline shot from the radiator and tanks. They dashed into my face, covering my goggles. One leg of the leather "X" had worked in toward my neck. I thought it was cutting my head off. Before I could brush off my goggles, the ship fell in a dozen directions. When I could see again, the Fokker was half diving, half side-slipping toward the earth at a terrific speed. I was only 800 feet from the ground when I got it under control.

IN THE days when wooden propellers were the only ones used, broken blades were common. Metal "props" have practically eliminated that trouble. But a nicked or bent blade may cause vibrations severe enough to pull loose a motor. If this happens in the air, cut everything and land. I once saw an accident at an air field that shows how quickly a damaged propeller can loosen an engine. A student nosed over in landing and broke off one blade of his "prop." He thought he would use the half-propeller to taxi to the hangar. Before he could get back to the throttle to cut the gun, the uneven pull of the damaged screw had torn out the engine.

To prevent nosing over and damaging a blade in taking off or landing, a pilot should study his field. If it is covered with high grass, gravel, or mud, offering resistance to a taxiing ship, the tail should be kept well down. On a smooth field, the tail should be kept high on a take-off run. Otherwise the ship may take to the air before it has attained full flying speed.

I remember once I was glad to see my propeller dig into the ground. It got me out of a tight hole—for I was flying a ship that couldn't land.

This was the way of it. I had flown from Buffalo to Long Island. Headwinds had held me back. When I arrived over Curtiss Field, the wind became a gale. At times it attained a velocity of sixty-five (Continued on page 150)

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miles an hour. Trees lashed about, bending like bows. In a fleeting glimpse, I caught sight of three mechanics struggling to hold a plane half sheltered behind a hangar. One ship had been caught in the open. The gale had rolled it across the field like a tumbleweed. It was smashed to kindling. Once my plane was carried backward half across the field, hanging with racing motor in the teeth of the wind. Three times I tried to land. Each time the howling gale picked me up like a feather. Once the wheels stayed on the ground for fifty feet. Then they struck a tiny bump and in the winking of an eye I was sixty feet in the air. The plane was slapped up and down, to right and left. I rocked the stick continually to keep the ship level. Sweat ran down my face. The gasoline was getting low. A dead engine and—well, that would be too bad.

THE suspense ended suddenly. I tried a desperate experiment I had planned for just such an emergency. Swinging low, I dove into the ground. Because the speed of the plane was little more than that of the wind against which it was flying, the ship was moving slowly in relation to the ground, so it was not washed out. The whirling propeller dug into the earth. It held like an anchor, keeping the ship from being blown into tangled wreckage.

As I have thought it over afterwards, that way of meeting that emergency seems the right one. Skimming close to the earth and then diving head-on means a gambling chance to save both ship and pilot. The irony of the adventure was that five minutes after I crashed, the gale died out completely.

Flying is simple—until you meet the unexpected. It is conquering the unforeseen that measures the ability of an airman.

Here Are Correct Answers to Questions on Page 51

1. The labyrinth and semicircular canals of of the internal ear are the balancing instruments of the human body. They are filled with fluid, into which project innumerable tiny hairs. As the head is bent these tiny hairs are also bent in a corresponding way, and nervous impulses are transmitted to the great central exchange system, the ganglia, and, in turn, impulses are sent to the proper muscles to correct the balance.

2. Sneezing is violent and involuntary expiration of the air from the nose and throat caused by irritation of the nerves ending inside the nose or by stimulation of the optic nerve by an excessively bright light. Sneezing may be a symptom indicating that the victim is catching cold, or it may be caused by dust or other foreign body. In either case it is Nature's method of clearing out the passages.

3. The muscles are composed of tiny fibers which contract under stimulation from a nerve impulse. They become short and fat instead of long and thin, and thereby perform useful work. A human muscle is essentially a heat engine just as is a gasoline motor, but it works in a somewhat different way. Instead of directly burning hydrocarbons to produce water and carbon dioxide as does the gasoline motor, the muscle burns glycogen, changing it into lactic acid. Whenever the lactic acid content of a muscle is increased through exertion until it forms one three-hundredths of the total weight, the muscle is completely exhausted. When the muscles of an athlete reach this condition the athlete drops to the ground exhausted. Oxygen is absorbed from the air by way of the lungs to (Continued on page 151)

Here Are Correct Answers to Questions on Page 51

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reconvert the lactic acid to glycogen, and carbon dioxide is given off. The actual mechanism of muscle contraction is not yet known.

4. The growth of cartilage and bone is controlled by a small gland inside the skull and attached to the base of the brain. It is known as the pituitary gland. This gland is overdeveloped in extremely tall people.

5. Rheumatism in the human body is akin to running out of oil with an automobile. Every joint in the bony frame of the human body is supplied with a lubricant. This lubricant is supplied by the cells which form the cartilage lining the joints. Normally, the amount of lubricant produced corresponds exactly to the pressure on the joint and the amount of motion it goes through. In the disease called rheumatism, the cartilage cells do not break down into lubricants as they should, and for lack of lubrication the joints become stiff, and excessive wear occurs. Bone-building cells, in a desperate attempt to correct the condition, throw out gnarled outgrowths of bone all around the affected joints.

6. The muscular action of the heart, which circulates the blood through the body, goes on from birth till death entirely without the voluntary control of the brain. The nerve impulses which control the heart action—speed it up when exercise results in heavy demand for blood, and slow it down in sleep—are produced by the reflex nerve centers in response to nerve impulses sent into these centers by the various parts of the body.

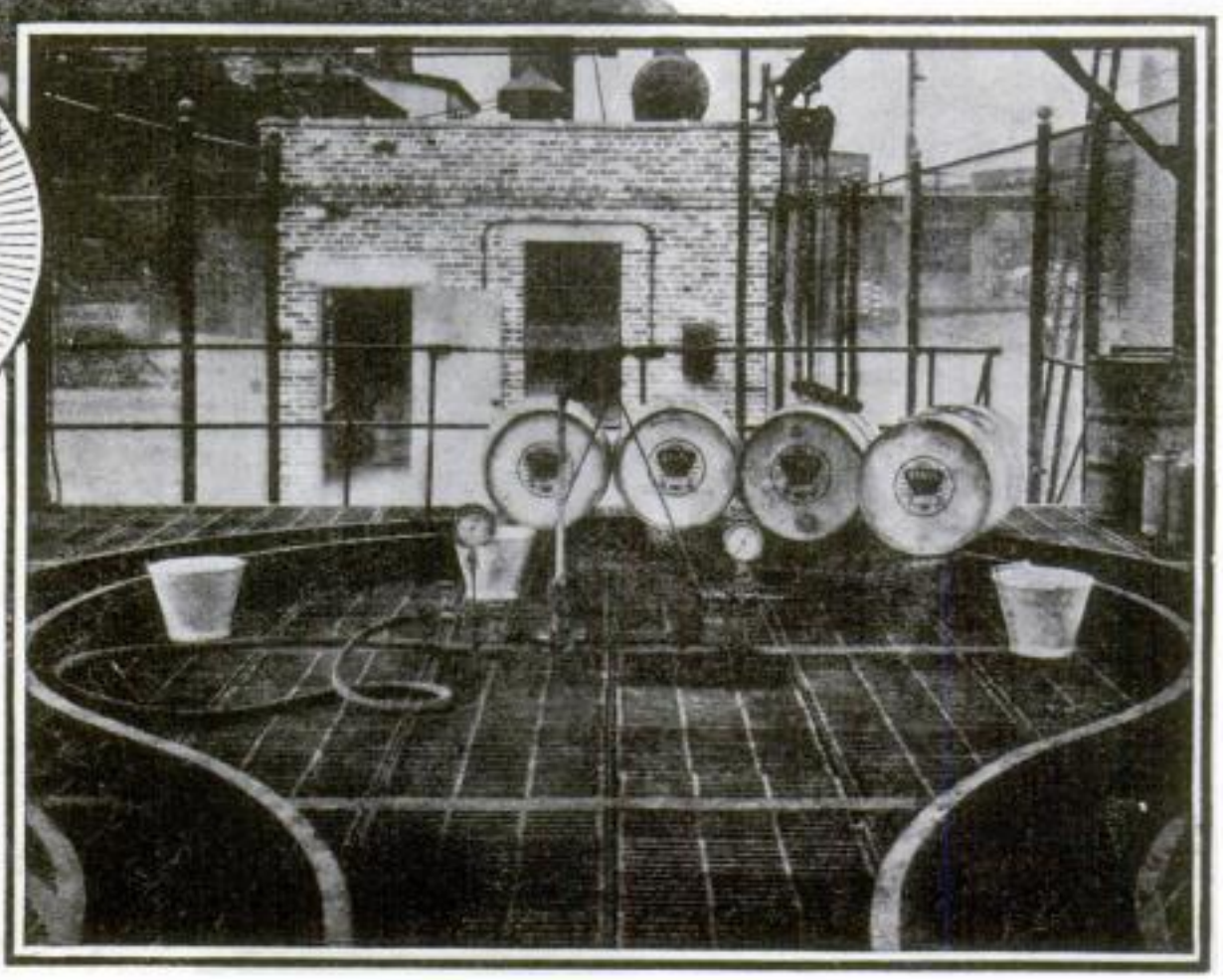
7. When a runner starts a race his heart is pumping blood at the normal rate. The sudden action of the muscles in running produces large quantities of lactic acid in the muscles and the automatic impulses of the nervous system effect an immediate speeding up of the heart. The effect of this speeding up is not felt at once, however, for it takes an appreciable time for the whole system to get tuned up to the higher speed of operation. Then comes the point when the heart and lung action is approximately fast enough to take care of the energy being expended in the body and the runner has what is commonly known as his "second wind."

8. A nervous, high-strung person usually is in a state bordering on nervous exhaustion. Such a person continually uses more nervous energy, or rather wastes more nervous energy than a person of calm and phlegmatic disposition. Nervous prostration, for instance, is not a sign of too much nervous energy. It is rather the complete exhaustion of nervous energy and is caused by overwork, mental strain, or some other condition that demands more nervous energy than the system normally can produce.

9. Poisons act in many ways to destroy life. Ground glass, for instance, is a poison, but its action is purely mechanical. The tiny, sharp pieces of glass scrape and cut the lining of the stomach and the intestines and so produce such a severe inflammation that death results. Strong acids and caustic cause death by chemical means. They destroy the linings of the throat and stomach by precipitating them to form certain chemical compounds. A large class of poisons act by upsetting the nervous system. Some paralyze the nervous centers so as to stop the normal automatic nervous impulses which cause the organs of the body to function. Others so stimulate the nervous system that it is thrown entirely out of gear and some organ of the body runs away with itself like an engine when the governor breaks.

Left—Typical refinery scene with Ethyl mixing plant in foreground.

Below—Close-up of Ethyl mixing plant. Drums on runway contain Ethyl fluid about to be mixed with gasoline to form Ethyl Gasoline.



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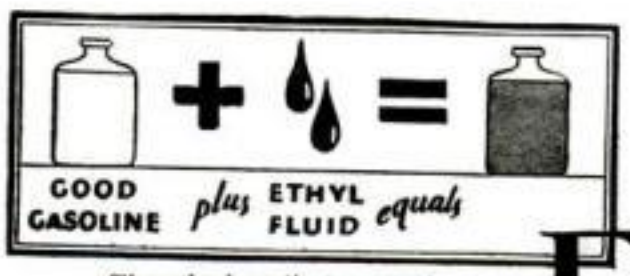

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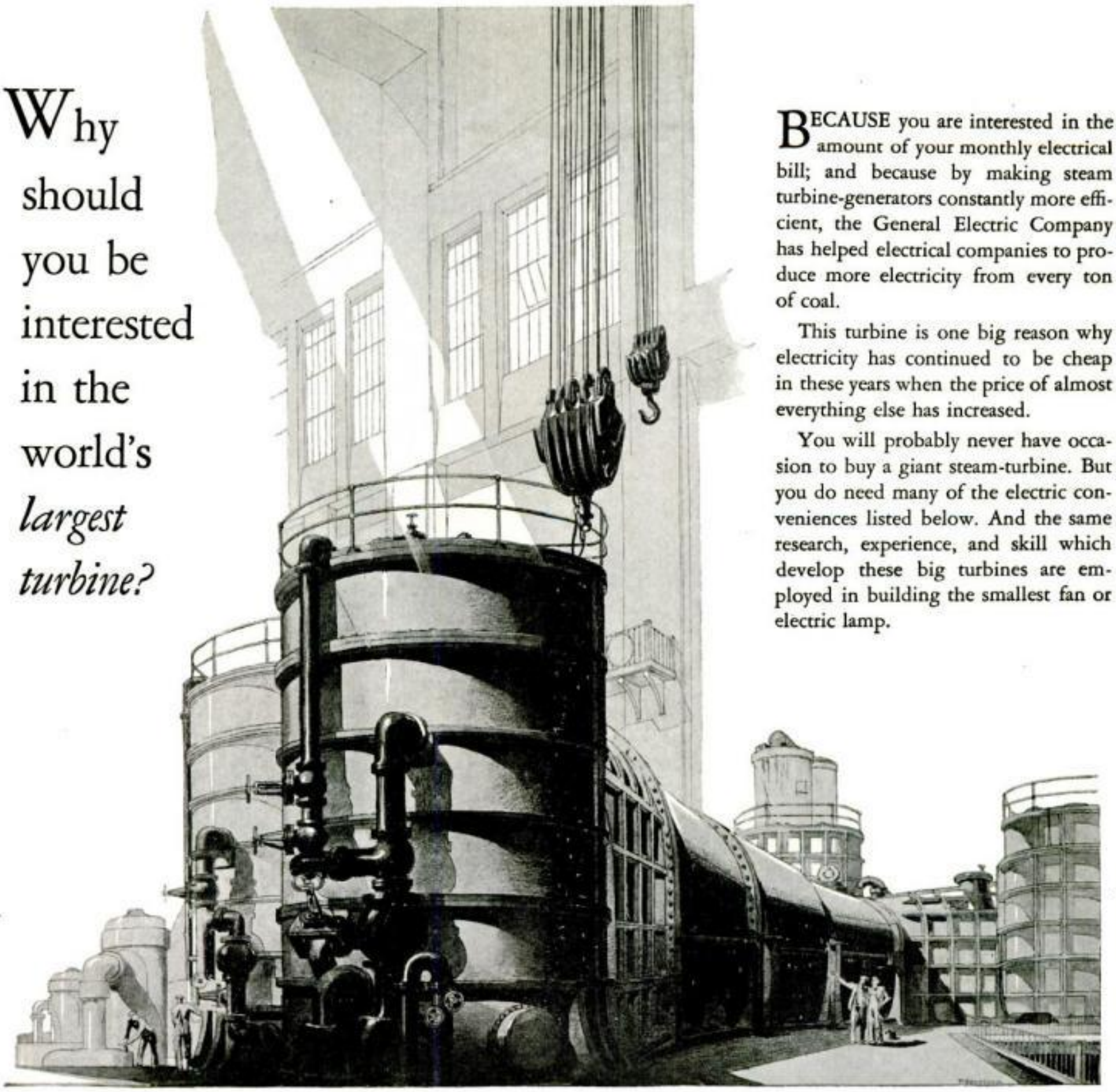

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